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ABSTRACT

Designed to help Wisconsin educators use computers effectively in the instructional environment, this guide emphasizes planning at the district and building levels for the integration of computer literacy competencies into various disciplines in the K-12 curriculum and the teaching of computer science as an elective at the secondary level. The manual is divided into eight major sections: (1) Perspectives (background and premise of the guide); (2) Model for Using Computers in Education (computers in both instruction and administration); (3) District Plan (planning process, philosophy and rationale, curriculum integration, facilities/resources, and budget considerations); (4) Implementing the District Program (staff development and software/hardware selection, acquisition, and management); (5) Evaluating the District Program (overview and evaluation checklist); (6) Modifying the District Plan and Program (overview, planning for change, analyzing/interpreting program evaluations, setting priorities, implementing change, and evaluating impact); (7) Computer Science (overview, definition, goals, scope and sequence); and (8) Resources (overview, curriculum planning, inservice resources, software evaluation resources, computer-related journals, computer software and instructional television packages, audiovisual materials, computer science, keyboarding, and computer equity). Five appendixes provide a summary of equity issues, a discussion of factors to be considered in teaching keyboarding, a hardware evaluation worksheet, program modification worksheets, and school district standards from the Wisconsin Statutes that affect computers in education. (RP)

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A Guide to Curriculum Planning in Computer Education

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Foreword

In the past four years, the Computer Education Task Force has been meeting to create guidelines that can help Wisconsin educators use computers effectively in the instructional environment. The *Guide to Curriculum Planning in Computer Education* is the latest task force effort. It is important not only because of its strong emphasis on planning at the district and building levels, but also because it incorporates a great deal of the thinking that has gone into the new Wisconsin Department of Public Instruction curriculum guides for other disciplines.

This guide approaches computer literacy as an integrated discipline. Computer and related technologies are having and will continue to have an impact on a variety of disciplines, professions, and vocations. The student computer literacy competencies suggested in this guide are those determined to be relevant for an "information age." Subject specialists from around the state have identified these competencies in a number of the DPI curriculum guides—for example, the importance of databases in the study of social studies and science and the use of word processing to support the writing process in language arts, social studies, science, and other disciplines.

Students can use computers as application and information access tools. In addition, computers can individualize education in a variety of ways, taking into account the learning style and speed that are best for each student.

Many of the student competencies in this guide suggest the need for curriculum changes in a number of disciplines. These changes must occur if we are to effectively educate Wisconsin students for success in the twenty-first century and for lifelong learning. Intensive staff development from inservice teachers and new goals for the education and training of preservice teachers will be required to bring about such changes.

Wisconsin school districts and postsecondary institutions have made great strides in preparing to meet the challenge of educating students for the twenty-first century. This guide is designed to help them continue that process.

Herbert J. Grover
State Superintendent

Acknowledgments

Members of the Computer Education Task Force contributed time, support, and assistance to production of the computers-in-education model and this curriculum guide.

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Background

The improvement and support of elementary and secondary school systems throughout America so that, by the year 1995, they will provide all the nation's youth with a level of education in mathematics, science, and technology, as measured by achievement scores and participation levels (as well as other non-subjective criteria), that is not only the highest quality attained anywhere in the world, but also reflects the particular and peculiar needs of our nation.
—Educating Americans for the 21st Century

Computers are being used increasingly as tools in many occupations. As a result, the need to prepare all students—not just advanced math and science students—for a future with computers is increasing as well. Knowledge of the computer is basic to an understanding of the full range of procedures that may be applied to organizing information and solving problems in fields as diverse as mathematics, science, the social sciences, language, the creative arts, business, and industry. The goal of computer education, then, is to expose all students to computers and computer applications in a variety of subject areas.

Because computers and other electronic technologies are having a revolutionary effect on society, educational needs have changed and will continue to change drastically. Skills and competencies once deemed essential for success in this society have become far less important in the present "electronic age." As a result, if schools are to continue to play a major role in providing equal opportunities, they must make significant changes in all curricular areas.

Integrating computers into the school curriculum can expand educational opportunities for all students. However, if particular attention is not given to equity issues, the computer revolution has the potential to widen the gap between advantaged and disadvantaged, male and female, majority and minority students. The Computer Education Task Force and the Department of Public Instruction are committed to preventing this. To that end, they have included, in Appendix A, an article designed to heighten educators' awareness of how pervasive their concern for equity must be.

Several applications of computers provide indications of how previously important skills can become less significant and lead to questions which educators must address.

- What effect will widespread use of word processing and electronic spreadsheet programs have on the need to spend a significant amount of time teaching penmanship skills?
- What effect will widespread use of calculators and programmable computing devices have on the need to spend nearly eight years teaching computation skills?
- What effect will widespread access to comprehensive information retrieval services have on the need to teach factual information in all curricular areas?

Elementary and secondary school staff . . . must look not "back to the basics," but forward to the needs of future citizens.

In general, success in the electronic age will be less dependent on rote mechanical skills than on higher-level thinking and creative skills.

Elementary and secondary school staff must question the relevance of the content of instructional programs in all subject areas. They must look not "back to the basics," but forward to the needs of future citizens. Curriculum content must be continually reviewed and changed.

For many of today's children, a major portion of experience involves electronic communication devices such as televisions, computers, and video games. These are the "natural" tools of their time. In contrast, previous generations were more print-oriented and, as a result, more receptive to learning from print media. The effectiveness of education can be significantly improved by increased use of electronic educational tools that take students beyond traditional curriculum and learning activities to future-oriented curricula and problem-solving activities not previously available.

Effective implementation of computer use in the schools should be based on the following principles.

- Computers should be integrated into the curriculum with *an orderly and well-defined plan*.
- Implementation of an effective computer plan requires sufficient district resources to support staff development, curriculum development, and software and hardware acquisition.
- Students of all ability levels, races, and ethnic groups; students of both sexes; and students with all types of handicaps can and must use computers.
- District personnel should make a commitment to computer literacy as a basic skill for all students.
- All classroom teachers are capable of using the computer as an instructional tool. Adequate staff development programs must be provided to insure the effective use of computers in education.
- Computers should be considered superior instructional tools in some situations and inferior ones in others. The versatility of computers allows them to provide instructional support in all disciplines.
- Computers should support instructional management through success prediction, monitoring of student progress, vocational guidance, and education and career planning.
- Computers allow teachers to concentrate on student needs and learning problems and to become more effective facilitators of learning.
- Computers should be made available in sufficient numbers so that students will have adequate opportunities to develop basic computer operation skills and to feel comfortable using the computer as a learning and problem-solving tool.
- The rapidly evolving nature of information technology demands constant awareness and revision of current classroom practice to maximize the computer's potential as technology changes society.

Computers allow teachers to concentrate on student needs and learning problems and to become more effective facilitators of learning.

A major emphasis of a computers-in-education program must be on the computer as a problem-solving tool. Educators must be cognizant of the possibilities of using computer capabilities to develop higher-level thinking—analysis, synthesis, and evaluation. The computer gives students opportunities to make decisions and be actively involved in learning and selecting learning activities, rather than passively accepting predesigned activities. If school district personnel study and carefully consider the potential of computer technology, they can use it to nurture creative, rather than conforming, student behavior.

Premise of Guide

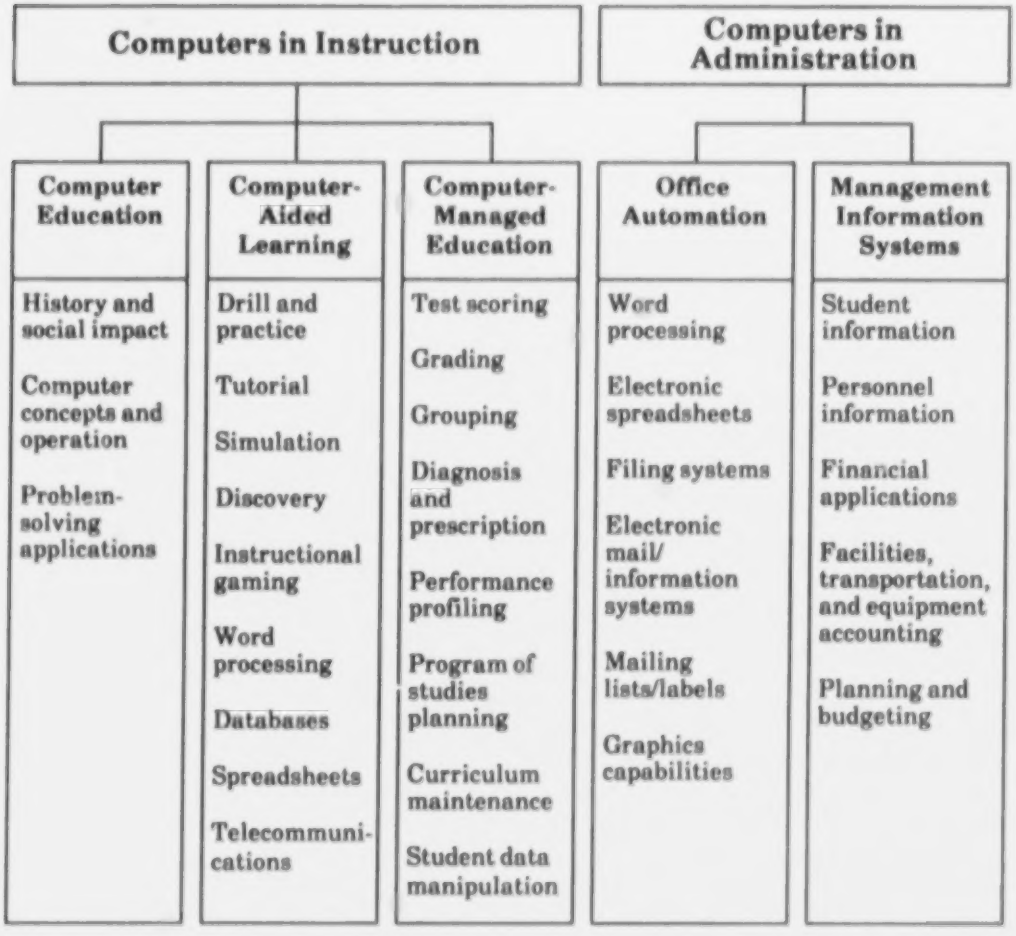
The material presented in this guide is based on the premise that computer literacy competencies should be required of all students in kindergarten through grade 12 (K-12). *Computer science*, as distinct from computer literacy, is treated as an elective discipline for students in secondary grades 7 through 12.

Computer literacy is given a two-part definition for the purposes of this guide. The computer literate can use suitable computer programs in appropriate ways to help them learn, handle information, and solve problems. They are also able to make informed judgments concerning social and ethical issues involving computers and information systems.

The computer literacy competencies in this guide are designed to be integrated into various disciplines in the K-12 curriculum. The recently published Wisconsin Department of Public Instruction curriculum guide series was used as one basis for determining the contexts in which these competencies might best be taught.

Figure 1

Computers-in-Education Model



The computers-in-education model introduces the use of computers in instruction and in administration. The model is intended to help educators teach the computer as a subject of instruction and use the computer as a tool in teaching the school curriculum and as an aid in the management of instruction. The model also provides an overview of the use of computers in administration. This topic is covered more thoroughly in DPI Bulletin No. 4907, *Suggestions for Reviewing School District Administrative Data Processing Needs*.

Computer Education

Computer education addresses the need to learn about the computer itself as a subject of instruction. Topics included in this strand are the impact of the computer on individuals and society, computer definitions and terminology, and how computers can be utilized or programmed to analyze and generate solutions to real-world problems.

History and Social Impact

This component of computer education should provide information on the historical development of the computer and its role in present-day society. Students should be made aware of some of the ways in which computers touch everyone's life. Careers that require computer use should also be highlighted.

Societal, legal, and ethical issues involved in computer use must be dealt with in addition to the educational issues. Finally, time must be given for a look toward the future. The implications of computer use in artificial intelligence, robotics, telecommunications, and the like are important topics for discussion.

Societal, legal, and ethical issues involved in computer use must be dealt with . . . .

These topics can and should be handled wherever appropriate in all curricula taught in a school.

Computer Concepts and Operations

Students studying computer concepts and operations should gain

- an understanding of common words used in computer environments;
- the ability to identify key hardware components and knowledge of their functions, capabilities, limitations, and relationships to software; and
- experience using the computer keyboard for operations such as sound generation and graphics and experience using software for inputting, outputting, and saving data.

Problem-Solving Applications

To use computers for problem solving, students must understand the problem-solving process, select the appropriate tool, and find and use applicable software. The applications fall into two broad areas:

- working within the computer system with such software as electronic spreadsheets, information retrieval systems, word processing programs, and so on; and
- using the computer to interface with external devices that control or collect data, such as CAD/CAM (Computer-Assisted Design/Computer-Assisted Manufacture) programs, robotics, timing and measuring devices, environmental controllers, and so on.

Programming

Programming involves communicating with programmable devices so that they will react to users' requests. This is accomplished by developing algorithms, designing flow charts, coding information in a format the machine understands, entering the information, and "debugging" the program. Computer programming instruction teaches students the commands needed to communicate using computer languages like Logo, BASIC, or Pascal.

Logo. A discovery-oriented, structured language, Logo is used when the computer is to be a device to help students think, experiment, and discover.

BASIC. This language is most readily available for student use, as it is built into the majority of computers sold for home and school.

Pascal. This structured, procedure-oriented language is the basis for the advanced-placement computer curriculum.

A district program may also include instruction in the Fortran, Cobol, assembler, and machine languages. Courses for the study of computer systems, systems design, and design logic may also be provided.

Computer-Aided Learning

Computer-aided learning involves opportunities to use computer programs as effective instructional tools in the same ways other media are used. The computer becomes an instructional tool for initial teaching, drill and practice, inquiry, problem solving, tutoring for remediation, enrichment, and learning reinforcement in many areas of the curriculum. Well-developed computer software can add dynamic and interactive versatility to the learning process. There are a number of types of instructional software.

Drill and practice programs review and reinforce concepts or skills already taught.

Tutorial programs introduce and explain concepts and facts; they may provide initial exposure to materials.

Simulation programs are designed to model real-world environments with which students can investigate areas of mathematics, social studies, ecology, physics, chemistry, and so on. Simulations allow students to make decisions and interact in situations that are often historical, or too complex, expensive, dangerous, or distant to be brought into the classroom.

In many schools today, the phrase 'computer-aided' instruction means making the computer teach the child. One might say the computer is being used to program the child. In my vision, the child programs the computer. . .

—Seymour Papert
Mindstorms

Discovery computer programs are used to develop cognitive problem-solving abilities in specific subject areas such as math, language arts, social studies, and others.

Instructional games are designed to hold a user's attention and interest while teaching logical thinking or to make practice less tedious.

Word processing programs use the computer and specialty software to facilitate the writing, editing, formatting, and printing of reports and other written documents.

Databases use the computer to collect, organize, retrieve, sort, display, and print data of all kinds.

Spreadsheet programs use the computer and specialized software to simulate a business or scientific work sheet. Data entered into "cells" in the electronic work sheet can be manipulated automatically by the spreadsheet program.

Telecommunications programs use the computer and communications software to input, transmit, sort, receive, and display information from various sources.

Computer-Managed Education

The computer can also be used as a manager of instruction and of the educational setting, and there is a wide variety of computer-managed education software. A large subset of software is subject oriented and is often referred to as CMI (Computer-Managed Instruction).

For example, some software programs include card readers that can automatically score tests students complete at their desks and enter grade data into the computer. The computer can then diagnose students' areas of weakness and suggest prescriptions of various textbooks or other non-computer media. The teacher must select for each student the most appropriate assignment, which the computer then records in each student's record.

In addition to CMI software, there is another subset of software that deals with related specific tasks.

Test Scoring. Machines called card readers or scanners are attached to the computer. Students' answer sheets are machine scored and the resulting data is put into computer memory.

Grading. Once test data is entered by hand or machine, it is graded according to the teacher's guidelines, and grades are placed in each student's computer file.

Grouping. Recommendations based on test scores can be provided for dynamically forming and reforming groups for instruction.

Diagnosis and Prescription. The computer evaluates student progress and, knowing the curriculum objectives and the relevant school resources, makes prescription suggestions for teachers to select.

Performance Profiling. Individual or group student progress can be profiled on the basis of any chosen set of objectives.

Program of Studies Planning. A specific set of objectives can be tracked across many subject areas. This function can be used in the development of individual education plans (IEPs).

Curriculum Maintenance. A districts' goals and objectives for students change over time, so the computer program allows for additions to, deletions from, and modifications of curriculum and resource data.

Student Data Manipulation. Lists of student data—students by home room, telephone numbers by class—and lists of addresses, emergency medical data, and other types of information can be generated.

Implementation of computer-managed instruction requires a considerable commitment of staff time and district resources.

Implementation of computer-managed instruction requires a considerable commitment of staff time and district resources. It is wise to consider carefully the following questions before proceeding with a CMI project.

- What level of implementation is desired: single classroom, multiclassroom, or districtwide?
- What amount of inservice training is necessary to begin?
- Do district staff want to work with objectives created commercially, modify commercial products, or build their own database?
- How much time is necessary for preparation?
- How often will the database be evaluated and modified to make sure it meets current instructional needs?
- Do those persons implementing the program have an investment in its success?
- Do district staff have data from a pilot project that can be used to estimate expenses if they expand the scope of their efforts?

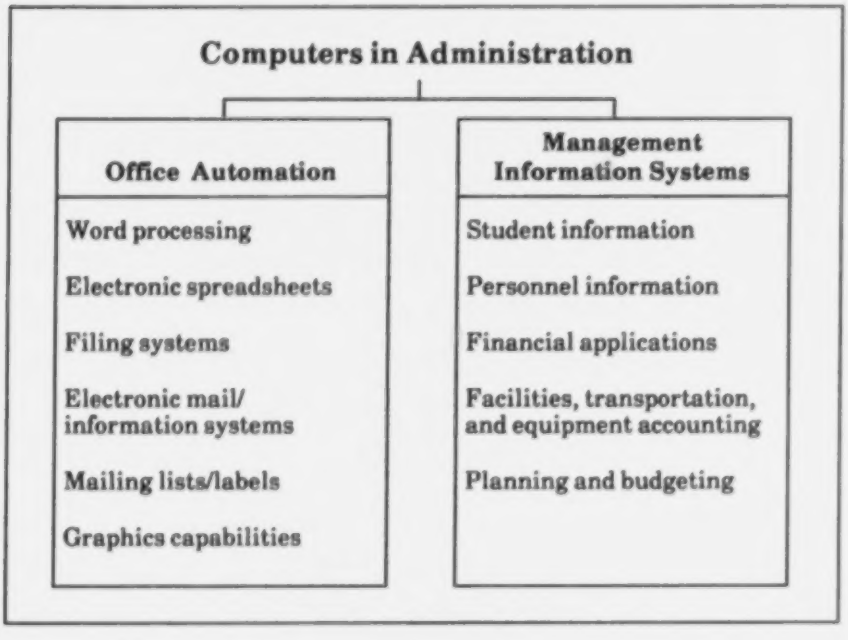
- Do staff know the advantages and disadvantages of bringing in a computer? Did they make the final determination on the degree of computer involvement?

Computers in Administration

In office automation and management information systems, the computer is used as a tool to help when

- massive amounts of data are processed through well-defined operations,
- processing is repetitive,
- processes are repeated under a variety of conditions, and
- processing speed is important.

Figure 2



A number of administrative functions within a school district fit into one or more of these categories. The desire and need for information at both the local and state levels can dramatically increase interest in administrative computer applications.

Other examples of ways computer management information systems can be used are listed below.

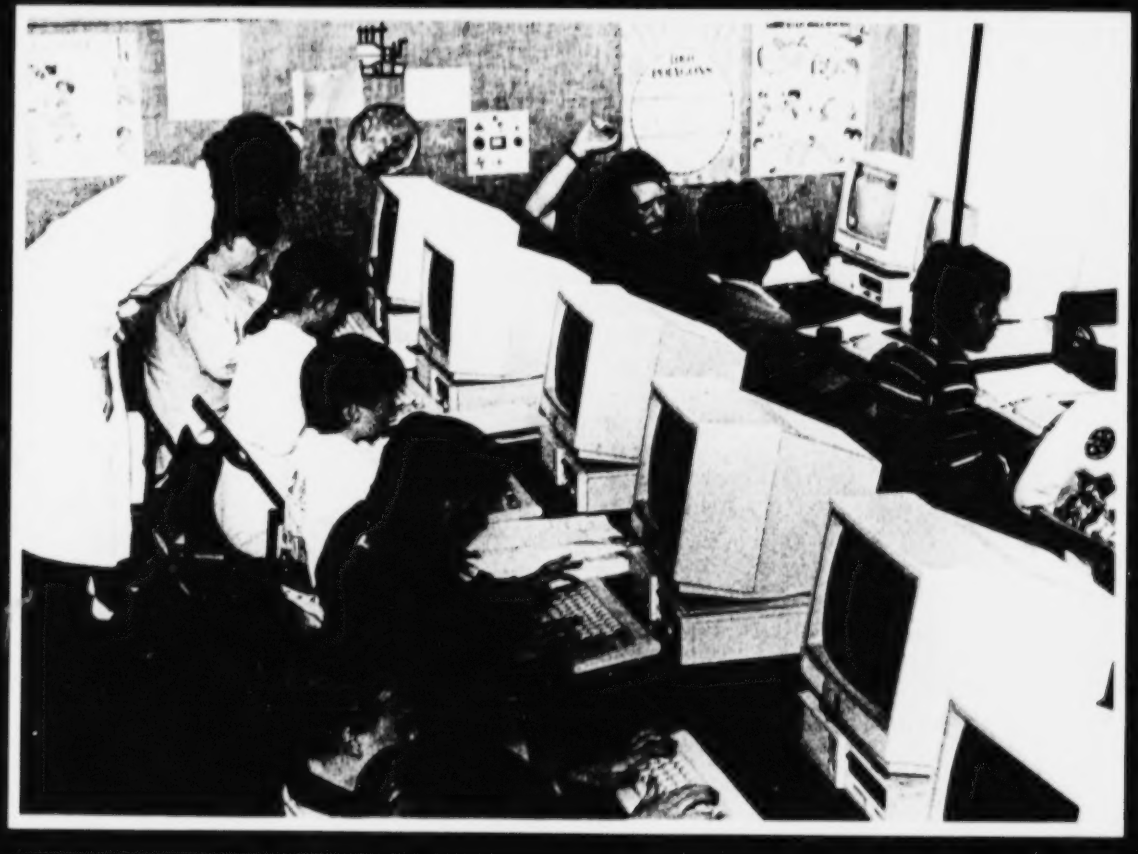
- Student information
  - —scheduling
  - —grading

— attendance taking
— exceptional education data compilation

- Personnel information
  — payroll
  — personnel data, for example, certification, fringe benefits, seniority
  — negotiations
- Financial applications
  — accounting
  — investing/borrowing
- Facilities, transportation, and equipment accounting
  — bus routing
  — inventory/fixed assets
  — building/vehicle/equipment maintenance
- Planning and budgeting
  — census
  — budget development

The Department of Public Instruction offers Bulletin No. 4907, *Suggestions for Reviewing School District Administrative Data Processing Needs*. It was designed by the Division for School Financial Resources and Management Services to help districts assess their data processing needs, consider alternatives, plan for installation and implementation of a computer system, and review system performance. The process outline provided is designed to be used by those districts investigating their first computerized system as well as those considering a transition from one system to another.

For a free copy of *Suggestions for Reviewing School District Administrative Data Processing Needs*, contact Bambi Statz, Division for School Financial Resources and Management Services, Department of Public Instruction, Post Office Box 7841, Madison, WI 53707-7841; (608) 266-6968.

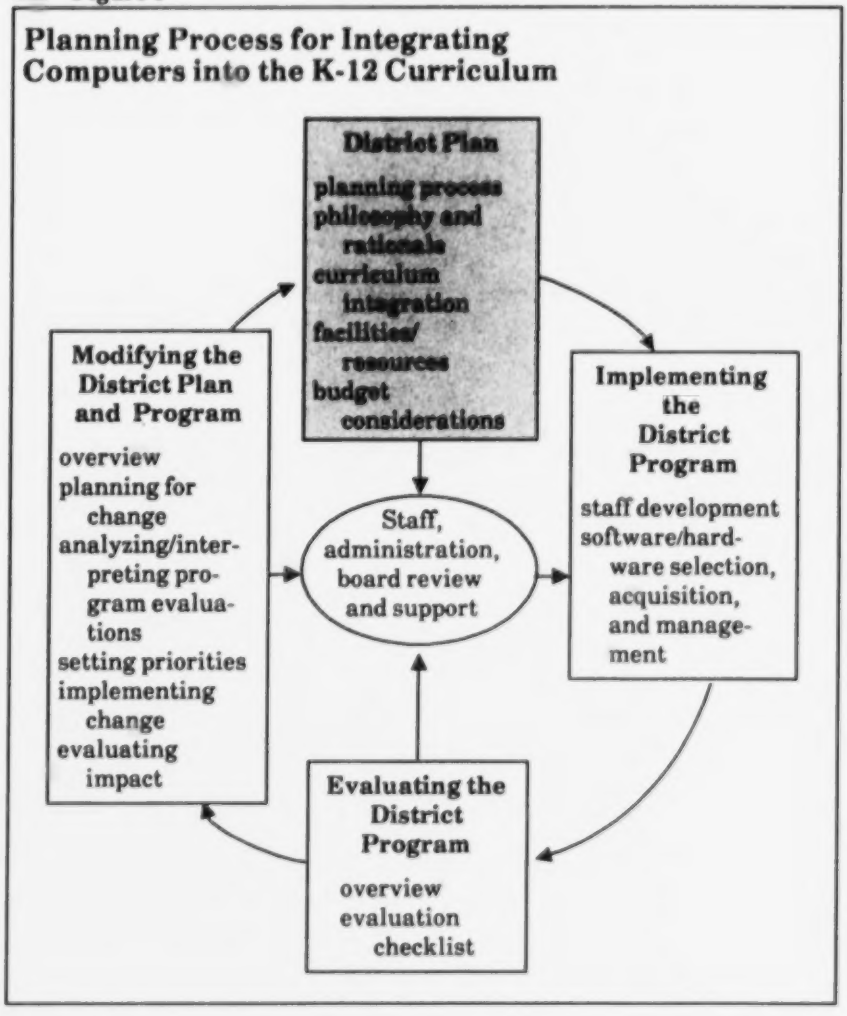


Planning Process

Before the computer, every communications medium or device was essentially dumb. If it worked right, it delivered at the far end exactly the message that a human being had put in at the start. There could be noise or attenuation, the paper could tear, but the medium added nothing positive. What a human being put in, a human being could take out, and that was all. Now for the first time, the message that goes in is not necessarily the message that comes out. For the first time, thanks to digital logic, messages may be modified or even created in the machine.
—The Culture of Electronic Print

Decisions about the use of computers in education should be based on a carefully written plan. The plan should encompass all of the current and projected uses of computers within a school district as outlined in the computers-in-education model in Section 2. The planning process should involve shared decision making on all aspects of the district plan. The figure below gives an overview of various points which must be considered in the development of a district plan and its implementation. The various components of the figure are discussed in Sections 3, 4, 5, and 6.

Figure 3



If instructional computing programs are to be implemented effectively, there must be a mechanism for establishing responsibility, for providing appropriate resources—materials, services, equipment—and for making decisions. If this mechanism does not exist, it will have to be created. Program development and implementation require community, school board, and administrative support, as well as broad-based staff commitment. The planning process should facilitate a synthesis of support for computers in education among these groups.

Assigning Responsibility

The first requirement is for the school administration to designate an *individual who will assume major responsibility for districtwide planning and coordination of computers in instruction.* Ideally, this person should be well trained and experienced in educational computing and curriculum planning and development. It is important for the coordination role to be delegated to someone who possesses skills in organization and whose leadership is accepted by the staff.

The person assigned as district computer coordinator must have the responsibility, as well as the authority, to call and conduct meetings, communicate freely with staff members, train staff members, and manage facilities.

Creating the Advisory Committee

Instructional program planning is a complex task which should not be vested in one individual, regardless of personal qualifications; therefore, a second step is to appoint an instructional computing committee to coordinate the planning. The designated district computer coordinator should act as chair of the committee and serve as a liaison person within the district.

Structure

The computers-in-education advisory committee should be broadly representative of all groups to be affected by the integration of computers into the curriculum. It should include representatives from each building, various grade levels and disciplines, the administration, the board of education, the community, and the student body. It is also important to include both genders, race representatives, and members of ethnic groups to help assure equal access to computers across the district.

The computers-in-education advisory committee should be broadly representative of all groups to be affected by integration of computers into the curriculum.

The members of the committee may be selected from individuals who demonstrate

- the ability and willingness to implement instructional computing in kindergarten through grade 12;
- knowledge of and interest in computers;
- willingness to provide leadership in the district, as well as at the building level; and

- willingness to deal with philosophical and ethical issues, including equity issues.

Committee members should be appointed for a term long enough to insure continuity, with provision for new personnel to be appointed periodically.

Responsibilities

The tasks of the computers-in-education advisory committee might include

- formulating a K-12 district plan for integrating computers into the curriculum;
- implementing a computer training program for teachers, principals, and administrators;
- developing implementation plans;
- coordinating equipment use throughout the district;
- making budget recommendations;
- developing a process for revising the district plan and implementation procedures as needed;
- writing computer hardware and software acquisition, copying, and management policies;
- developing guidelines for access—for example, rules for using computer hardware and software both on and off the premises;
- reviewing and recommending appropriate articulation for curriculum proposals from other disciplines;
- setting long-term as well as yearly goals; and
- informing the community about the program.

Operational Procedures

To insure its effectiveness, the computers-in-education advisory committee should have clearly defined operational procedures based on commonly accepted committee practices, including

- a written agenda for each meeting,
- written minutes of each meeting,
- established time lines for committee projects,
- a procedure for delegating tasks to appropriate subcommittees, and
- clearly identified roles/responsibilities for the mission of the committee.

Educating the Committee

There are no foolish questions. No man becomes a fool until he stops asking questions.
—Charles Steinmetz

Because the committee will play a critical role in the decision-making process, it is essential that members have sufficient knowledge, insight, and experience to make informed decisions. Therefore, opportunities should be provided for all members to attain the highest degree of competence as specified in the implementation section of this document. Adequate resources of both time and money should be available to the committee.

This high degree of competence is directly related to the major leadership role of the committee, which is to

- assess the current status of computer use,
- project desired student competencies,
- determine where student competencies will be taught, and
- develop an implementation plan to help students gain the desired competencies.

Philosophy and Rationale

Every educational program should be rooted in, and reflective of, a carefully considered educational philosophy. Therefore, when developing a plan for computers in education, district staff must also establish a district philosophy regarding computer use. The following principles, among others, should be considered when preparing this philosophy.

Every educational program should be rooted in, and reflective of, a carefully considered educational philosophy.

- Computers should be integrated into the curriculum with an orderly and well-defined plan.
- Implementation of an effective computer plan requires sufficient district resources to support staff, curriculum, and faculty development.
- Students of all ability levels, races, and ethnic groups; students of both sexes; and students with all types of handicaps can and must use computers.
- District personnel should make a commitment to computer literacy as a basic skill for all students.
- All classroom teachers are capable of using the computer as an instructional tool. Adequate staff development programs must be provided to insure the effective use of computers in education.
- Computers should be considered superior instructional tools in some situations and inferior ones in others. The versatility of computers allows them to provide instructional support in all disciplines.
- Computers should support instructional management through success prediction, monitoring of student progress, vocational guidance, and education and career planning.
- Computers allow teachers to concentrate on student needs and learning problems and to become more effective facilitators of learning.
- Computers should be made available in sufficient numbers so that students will have adequate opportunities to develop basic computer operation skills and to feel comfortable using the computer as a learning and problem-solving tool.
- The rapidly evolving nature of information technology demands constant awareness and revision of current classroom practice to maximize the computer's potential as technology changes society.

Identifying district instructional needs is important when developing a comprehensive plan for computers in instruction. The information gathered from assessing the present is essential background data when developing a plan for the future. Although there are many areas to be

examined in the initial assessment process, some of the most pertinent requiring exploration are

- student needs for the increased knowledge, conceptual base, and skills required to succeed in further education, employment, entertainment/recreation, or other personal pursuits;
- teacher needs related to improving instruction; and
- school educational management and decision-making needs.

Districtwide goals are statements of general purpose and intent to foster educational excellence. The goals for instructional computer use should provide guidance and direction in the three areas addressed by the computers-in-instruction model—computer education, computer-aided learning, and computer-managed education. The goals should reflect identified student, teacher, and school needs.

Curriculum Integration

One of the most important roles of the computers-in-education advisory committee is to establish a plan which provides guidance for the use of computers for all three components of the computers-in-instruction section of the model shown page 6—computer education, computer-aided learning, and computer-managed education. Computer-related instruction should be integrated into existing curricula through a change process involving shared decision making.

Computer Education. As defined in Section 2, a computer education program should be designed to address the need to learn about the computer itself; the computer is the subject of instruction. A well-defined computer education unit would include information on history and social impact, computer concepts and operations, problem-solving applications, and programming. The following must also be determined—scope and sequence of learner outcomes, instructional strategies, integration with content areas, instructional resources needed, and evaluation procedures.

Computer-Aided Learning. Computer-aided learning involves the use of the computer as an instructional tool. The computer should be used to

- support the teaching of content-area skills, knowledge, and concepts;
- teach real-world computer applications related to content areas; and
- teach about computer use in occupations related to content areas.

Computer-Managed Education. Instructional management is the process that controls the content, context, duration, and pace of instructional events. Districts should explore the potential of the computer to facilitate this process. Decisions about the use of computers for instructional management should be based on the following considerations:

- level of implementation desired—single classroom, multiclassroom, or districtwide;
- amount of staff training needed;
- use of objectives created commercially, modified locally, or created locally;
- time needed for preparation;
- continuous evaluation and modification of the database to ensure that it meets current instructional needs;
- persons implementing the program, or who should have an investment in its success;
- availability of data from a pilot project that can be used to estimate expenses if district staff expand the scope of their efforts;
- staff knowledge of the advantages and disadvantages of using computers; and
- participation of staff in final determination of the degree of computer involvement.

Student Competencies

Computer literacy topics should be integrated into existing curricular areas. This makes possible implementation of a computer literacy program without a significant addition of instructional time. Further, since the computer will be, in some cases, a superior tool to those being used, learning in some subject areas may be significantly enhanced in the integration process.

Developing computer literacy competence by applying the computer to solution of everyday education-related problems can be motivational for students and, in turn, enhance the effectiveness of the computer literacy program. Finally, the marriage of computer literacy and content-area instruction can help students learn process skills which may be inadequately developed in the course of existing curricular efforts. Among such process skills are

- observation and data collection,
- data classification,
- hypothesis formulation,
- hypothesis testing,
- statistical modeling,
- problem solving,
- composition of information, and
- information presentation.

When assigning computer literacy competencies to be integrated into various curricular areas, planners should consider the following criteria:

- content-area appropriateness,
- student readiness,
- staff readiness,
- state of the art of software in the content area, and
- existing and proposed curriculum initiatives.

Curriculum integration can be achieved by following these steps.

- Specify the computer education competency to be integrated.
- Identify related content-area unit by
  - — reviewing district content-area curriculums and
  - — reviewing current computer education activities.
- Develop computer education objectives for the content-area unit.
- Specify computer education content to be added to the unit.
- Revise instructional procedures as needed to incorporate computer education content.
- Identify software and other resources needed.
- Identify hardware and facilities needed.

Micros will change virtually everyone's life by extending their education.
—Osborne Computer's Georgette Psaris
Infoworld

In order to effectively integrate computer literacy competencies into specific disciplines, district planners must determine what competencies will be taught and which discipline will assume primary responsibility for teaching each competency. The Computer Education Task Force made some basic assumptions in the development of the Computer Literacy Integration Matrix for this curriculum guide.

- Each designated grade level was determined by the age at which students would be ready to deal with particular computer literacy topics.
- The designated grade levels and content areas represented places where specific computer literacy topics should be explicitly taught as part of an instructional activity. It was hoped that computer literacy knowledge, content, and skills would be applied to learning in all subject areas as appropriate.
- An attempt was made to designate one primary core content area into which each computer literacy topic would be integrated. Exceptions were made when unique capabilities could apply to different content areas.
- The designations are recommendations only. They were based on the experiences of the task force members and on information obtained from the DPI curriculum guide series. They should be adjusted and adapted based on local factors such as
  - — readiness of the teaching staff,
  - — existing district computer education efforts,
  - — existing content-area curricular emphasis, and
  - — state-of-the-art computer software.
- Particular attention should be paid to the distribution of the computer education topics across grade levels and content areas.
- The Computer Literacy Integration Matrix which appears on the following pages is based on the task force's current perspective of what lies ahead. It is a view through "a 1987 window to the future" and necessarily will have to change to take into account the volatility of the hardware and software industries. A district computer education program should evolve with the forces of change at work in society.
- The matrix represents an ideal program as viewed through "a 1987 window." It is a projection of the competencies students will need to be fully functioning citizens when they matriculate from the public school system.

Computer Literacy Integration Matrix

History and Social Impact of Computers

Student Competencies	Disciplines																						
	Elementary K-6							Secondary 7-12															
The student will be able to —	K	1	2	3	4	5	6	Math	Science	Social Science	Language Arts	Computer Science	PE/Health	Foreign Language	Music	Art	Bus. Ed.	Tech. Ed.	Home Econ.	Marketing	Agriculture
• demonstrate a knowledge of the history of computers.					← Soc. Stud. →					X		X					X	X			
• describe how people's lives are affected by the everyday applications of computers.	← Social Studies →								X	X								X	X		
• recognize the role and impact of information in society.					Soc. Stud. ← → Lang. Arts					X							X			X	
• demonstrate the capabilities of computers and future implications of technology in society.					Soc. Stud. ← → Science				X	X		X					X	X	X		
• demonstrate an awareness of careers associated with computers and the impact computers will have on all careers					← Soc. Stud. →					X							X	X			
• demonstrate an understanding of the potential of artificial intelligence and awareness of its implications.									X			X									
• demonstrate knowledge of robotics and its impact on society.	← Mathematics / Soc. Studies →								X	X		X						X			

Computer Concepts and Operation

Student Competencies	Disciplines																						
	Elementary K-6							Secondary 7-12															
The student will be able to —	K	1	2	3	4	5	6	Math	Science	Social Science	Language Arts	Computer Science	PE/Health	Foreign Language	Music	Art	Bus. Ed.	Tech. Ed.	Home Econ.	Marketing	Agriculture
• identify and explain the components of a computer system.	← Media Skill →																						
• define and use computer terminology.	← Media Skill →																						
• demonstrate proper procedure for using a microcomputer and prepared software.	← Media Skill →																						
• use the keyboard as a simple input device.	← Media Skill →																						
• demonstrate keyboarding skills.					Media Skill →						X	X					X						
• demonstrate procedures for storing and retrieving data.	← Media Skill →							X	X	X	X	X			X	X	X	X					
• determine whether specific computer configurations are appropriate for a given application.									X		X						X	X					
• identify and demonstrate the use of various peripheral devices.	← Media Skill →								X		X				X	X	X	X					
• use documentation and reference manuals to support computer operation.	← Media Skill →									X	X						X	X					

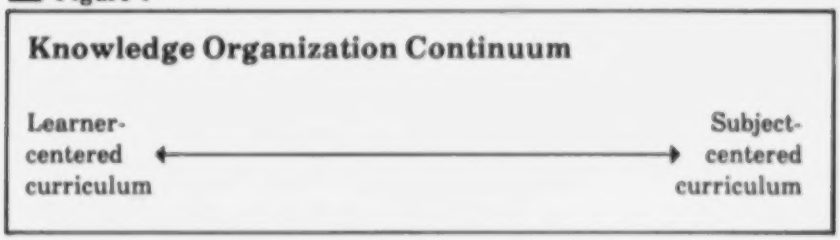
Problem-Solving Applications of Computers

Student Competencies	Disciplines																						
	Elementary K-6							Secondary 7-12															
The student will be able to —	K	1	2	3	4	5	6	Math	Science	Social Science	Language Arts	Computer Science	PE/Health	Foreign Language	Music	Art	Bus. Ed.	Tech. Ed.	Home Econ.	Marketing	Agriculture
• apply appropriate capabilities of word processing and related programs to complete classroom assignments.	← Lang. Arts →										X						X						
• apply appropriate capabilities of a database program to completing classroom assignments.				Soc. Stud. →				X	X	X							X						
					Science																		
• apply appropriate capabilities of a spreadsheet program to complete a classroom assignment.						Math →		X	X								X						
• create and use computer graphics.	Lang. Arts/Art/Science →							X	X			X				X	X	X					
• use online retrieval and communication.				Media Skill →																			
• use interfacing to collect data and control devices.				← Science →					X	X								X					
• apply capabilities of simulations to model real-life experiences.		Social Studies →							X	X													
			Science																				
• use programming technology to solve problems related to classroom assignments.	← Language Arts →											X											
		Mathematics																					
• apply appropriate capabilities of an integrated software package to complete a classroom assignment						Lang. Arts →						X					X						

Learning Process

This publication points to a wide variety of ways that computers shape and affect educational options. Its goal is to facilitate the integration of computers into all phases of learning. Recognizing the diverse forms that curriculum organization can assume is critical to maximizing the use of a wide spectrum of software in diverse educational settings. Curriculum planning requires choosing a method of organizing knowledge and selecting those who will make the decisions about this organization. One way to view this knowledge is on a continuum from learner-centered to subject-centered.

Figure 4



Learner-centered curriculum generally . . . seeks problems that unify and cut across subject areas . . . and teaches generalizable processes for a variety of settings.

Learner-centered curriculum generally emphasizes the interest of the individual, seeks problems that unify and cut across subject areas, selects content on the basis of the learner's knowledge map, and teaches generalizable processes for a variety of settings. Projects, activity centers, papers, and open-ended assignments are some of the instructional techniques used in learner-centered curriculum.

There is an abundance of general-purpose software programs particularly well suited for learner-centered curriculum. Since such programs are without content bias, they are equally useful in subject-centered curriculum. They are routinely used to collect information, search for problems, and manipulate ideas into solutions. They are generally called "application programs" or "productivity tools." The most commonly known of these tools are word processors and databases, but there are many more.

The Learning Process Matrix on the following page is provided to clarify the use of such productivity tools. It is a model showing the relationship between stages of learning/problem solving/creating and types of productivity tools.

Subject-centered curriculum dominates the structure of most courses today. It is generally designed to provide a comprehensive overview of a specialized subject area through the learning of a certain percentage of basic facts, ideas, and concepts. Content-oriented drills, readings, experiments, and simulations are some of the instructional techniques used in subject-centered curriculum. Drill and practice programs make up some 80 percent of the subject-centered instructional software available to date. Other common software types are tutorials and simulations.

Table 2

Learning Process Matrix

Curriculum Models		Computer Tools	
Learning/ Creating Process	*Thinking Skills*	*Personal Workspace*	*Global Workspace*
Explore	**Experience** **Search** Short-term memory **Record** **Organize** Long-term memory	Tutorials Simulations Personal databases Outline processors Drill and practice programs	**Search** Information utilities Online databases
Compose	**Organize** **Analyze** **Synthesize** **Revise**	Word processors Spreadsheets Programming languages Image processors still images animation Choreography processor Critical path method processor Music processors	
Evaluate	**Listen/react** Feedback ideas values Feedback mechanics	 Spelling/grammar/style checkers Programming checkers	**Communicate** Conferencing trees Bulletin boards
Perform	**Share** **Evaluate**	Desktop publishing	**Share** Information utilities Local area networks Online databases

Step-by-Step Analysis

As the Learning Process Matrix illustrates, learning may be described as taking place in four stages. Each stage of the process is discussed below and illustrated with the appropriate section or row from the matrix.

The learning process begins . . . with exploration of a situation or environment.

Explore. The learning process begins, as indicated in the far left column of Table 3, with exploration of a situation or environment. Students are given assignments or make choices about what to read, see, and do.

Cognitive scientists have concepts—short-term and long-term memory—that subdivide this exploratory stage of learning even further. Short-term memory is a temporary holding place, a buffer, for experiences. If any experience is perceived as boring, unimportant, or unconnected to previous experience, it vanishes from the short-term memory, leaving the learner free to search for and select new experiences. Tools students have traditionally used to gather information during the first phase of exploration are readings, experiments, and video programs.

Commonly available computer tools that can be used during this phase are called tutorials or simulations. In addition, the computer and telecommunications software can enable students to transcend geographic limitations to enter the global workspace. Electronic libraries, meetings, and bulletin boards scattered across North America can be accessed through the telephone lines.

■ Table 3

Learning Process—Stage One			
Curriculum Models		**Computer Tools**	
Learning/ Creating Process	*Thinking Skills*	*Personal Workspace*	*Global Workspace*
Explore	**Experience** **Search** Short-term memory **Record** **Organize** Long-term memory	Tutorials Simulations Personal databases Outline processors Drill and practice programs	**Search** Information utilities Online data

Telecommunications software can serve as a bridge between a personal computer and more distant computers.

Telecommunications software can serve as a bridge between a personal computer and more distant computers. During the first phase of exploration, students can search various databases and bring data across the telecommunications bridge to be stored in their local computer. They can explore information utilities for data on electronic special interest

groups and interact with these groups to get comments that may be pertinent to a specific topic.

The second substage of the exploration process requires what cognitive scientists call long-term memory. Every experience involves a winnowing out of the essentials, and the learning experience is no different. As data accumulates during the first stage of exploration, the learner notes items of particular interest or importance. A number of options for recording these noteworthy items is available. If some connect strongly to concepts already in the learner's mind, retention ability is enhanced. The items move into the learner's long-term personal memory. Drill and practice are traditional methods of improving long-term retention. Other retention aids are pencil and paper, camera, tape recorder, paintings, and so on.

Computer tools like outline processors and databases compete with more traditional means of recording and storing data. Computer tools can be seen as more difficult to use than other devices, because of the sometimes limited availability of computers and the training required.

However, electronic tools do bring significant new power to bear on the next phase of the long-term memory process. In addition to winnowing and storing, the long-term memory must also organize its findings. As data accumulates, it must be sorted into meaningful categories, or all data items will be lost in an indistinguishable sea of information.

This categorizing, and the continuous reordering of the relationships between the categories, is essential for the effectiveness of long-term memory and the acquisition of expertise. Computer outline processors are powerful aids when frequent restructuring of categories is required. When category structure itself is stable, databases can be used to search and sort. Further, databases can handle both images and texts.

The powers to manipulate information and reveal new relationships among and new perspectives on data elements or categories are the hallmarks of computer media.

The powers to manipulate information and reveal new relationships among and new perspectives on data . . . are the hallmarks of computer media.

Compose. The composition stage of the learning process, shown in Table 4, involves creation for the purpose of self-expression or communication or both. Creation generally requires the building of higher levels of organization upon those formed at the exploration stage. Material being studied is taken apart through analysis and reformed into a new synthesis. A number of computer tools in a variety of fields can be used for composition. They make possible electronic deleting, replacing, inserting, moving, copying, and formatting and are available for words, numbers, music, graphics, dance, programming, and planning.

Table 4

Learning Process—Stage Two			
Curriculum Models		**Computer Tools**	
Learning/ Creating Process	*Thinking Skills*	*Personal Workspace*	*Global Workspace*
Compose	Organize Analyze Synthesize Revise	Word processors Spreadsheets Programming languages Image processors still image animation Choreography processor Critical path method processor Music processors	

I said that an "expert" was a fella who was afraid to learn anything new because then he wouldn't be an expert anymore.
—Harry S. Truman

Evaluate. At the evaluation stage (see Table 5), continual feedback is needed for purposes of revision. One sublevel of evaluation deals with the basics, the mechanics of the composition process. Where grammar, syntax and style of the particular type of composition are clearly identifiable, computer tools can be created to check for proper or improper forms. Programming languages have programs to carry out this type of checking. Spelling and grammar checkers for the writing process are readily available. These programs do not revise automatically; rather they point out potential errors for the composer to correct.

The other sublevel of evaluation is feedback and criticism on the substance of the ideas and values expressed in the composition. There are no tools in the personal computer workspace that can carry out this function. Responsibility for it falls clearly on the composer. But assistance is, of course, always available from others, members of the composer's peer group or higher-level groups. The global workspace can again be used when geography or the uniqueness of a composition makes it necessary to look further for help with feedback and evaluation. Electronic meetings can be called on an individual or team basis using electronic forums such as conference trees or bulletin boards.

Table 5

Learning Process—Stage Three			
Curriculum Models		**Computer Tools**	
Learning/ Creating Process	*Thinking Skills*	*Personal Workspace*	*Global Workspace*
Evaluate	**Listen/react** Feedback ideas values Feedback mechanics	Spelling/grammar/ style checkers Programming checkers	**Communicate** Conferencing trees Bulletin boards

Perform. The performance stage shown in Table 6 is reached when a creator determines that the work is complete, the problem solved. Publication of most creations is done using some medium other than the computer for a variety of reasons, often because most in the potential audience do not have access to a computer. Wherever there is a common pool of computers, any computer creation—whether sound, image, or text—can be shared in the global telecommunications workspace. Telecommunications software serves as a bridge, this time for sending instead of receiving. The performance stage is critical in that it provides the motivation and generates the energy a creator needs in order to problem solve and invent again.

The performance stage . . . provides the motivation and generates the energy a creator needs in order to problem solve and invent again.

Table 6

Learning Process—Stage Four			
Curriculum Models		**Computer Tools**	
Learning/ Creating Process	*Thinking Skills*	*Personal Workspace*	*Global Workspace*
Perform	**Share** Evaluate	Desktop publishing	**Share** Information utilities Local area networks Online databases

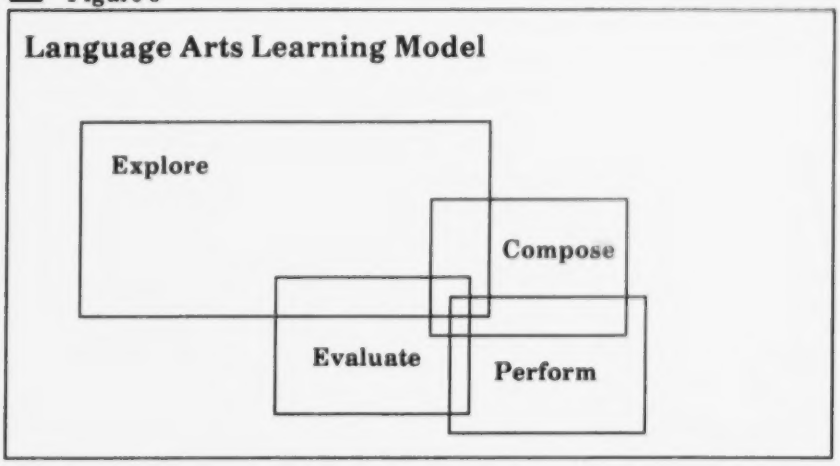
Every model, however, has its limitations. The Learning Process Matrix is a model that shows the relationships among the various software tools available for the development of complex thinking. An important feature of this model is the assumption that activities characteristic of all four levels or stages will be utilized in the course of a project or assignment. However, the matrix layout is not meant to indicate instructional sequence or the percentage of time to be spent on each stage. To gain that type of information, the educator must examine the learning process from another perspective.

Other Learning Process Models

In the figures that follow, the size of the block for each stage of the learning process indicates the proportion of time the learner should devote to it. The relative amounts of time devoted to the various stages and the roles the stages play change for different curriculum activities.

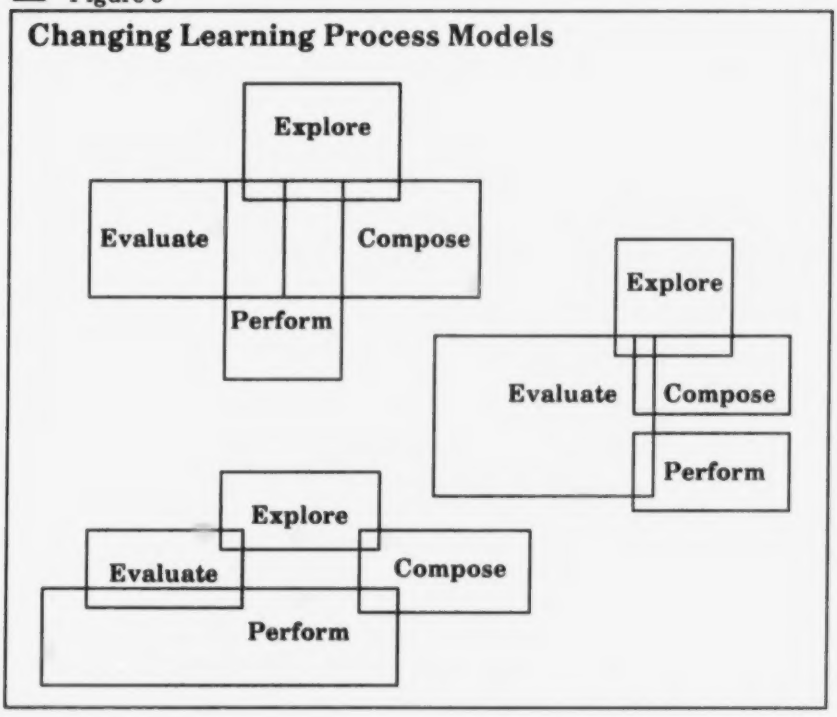
The "Explore" block in Figure 5 is for what some language arts researchers have called "prewriting activities." Their findings have indicated that educators should spend the bulk of the time devoted to written communication on prewriting—as much as 70 to 80 percent. More recently, other researchers have found that this disproportionate amount of time spent on exploration is a common configuration that applies to many learning situations.

Figure 5



The relative sizes of the blocks for all the learning stages should not be thought of as fixed. Rather, the lines around the blocks can be considered rubber bands that stretch with the demands of the task or problem at hand. The thinker/learner/creator may spend an equal amount of time on all the learning stages, a single stage other than exploration may take the largest amount of time, or multiple stages may dominate the learning process. Figure 6 illustrates some of the ways the learning process model may vary, depending upon the time devoted to each stage of the process.

Figure 6



Another feature of stages in the learning process is that they are not sequential or an ordered hierarchy. Though the order given in the Learning Process Matrix on page 25 may make sense and be commonly followed for thinking/creating/solving, it could be profitable to start at any stage, depending on the task or problem in hand, and to move directly from one stage to any of the others.

In addition, changing stages can happen quickly, almost simultaneously. For example, words and sentences can be evaluated for spelling and grammar while composition is being done. Further, it is assumed that processes overlap. One cannot respond—observe and record an event, for example—without evaluating which aspects of the event are important enough to be noted.

If the configuration suggested by language arts research (Figure 5) has any validity, it is likely that schools' current emphasis on word processing for composition will decline and use of tools like outline processors and databases that support prewriting activities will increase. The growth in the number of journal articles on classroom database use in 1986 provides some support for this prediction.

. . . it is likely that schools' current emphasis on word processing for composition will decline and use of tools like outline processors and databases that support prewriting activities will increase.

Future Problems

The Learning Process Matrix suggests that students involved in complex thinking will use computers increasingly throughout the thinking

process. This will create a significant problem, although it is one that is easy to define.

Take a set of popular computer software programs that would be useful to students involved in the writing process, for example. Among them might be an outline processor, a database, a graphics designer, a word processor, a spelling checker, and a telecommunications program.

The total number of unique key combinations, or computer commands, needed to operate all of these programs is likely to be in the hundreds. Even if only the basic or most frequently used commands are counted, the number for students to learn will still be very high. This problem will be compounded where different versions of the same tool are taught—a simple word processing program in a district's elementary school, a more powerful one in the middle school, and a sophisticated one at the high school.

The number of computer software commands students have to learn will significantly affect teaching time, student productivity, and student achievement.

The number of computer software commands students have to learn will significantly affect teaching time, student productivity, and student achievement. This is a critical variable for school district personnel to examine when planning for long-term selection of both software and hardware.

The industry itself is currently attempting to deal with this problem in two ways. Some software developers offer sets of integrated programs that use common commands. One computer manufacturer thus far has taken a more comprehensive approach, requiring that all programs written for a particular computer use the same commands for common functions.

As the types of new programs that may be invented and that students may want cannot be predicted, this second approach may allow for greater future flexibility. School computer use planners must weigh such options carefully, reducing the need to spend time teaching and learning computer commands whenever possible.

The Learning Process Matrix and the supporting figures also suggest a more generalized future development. Software tools will probably continue to make it easier for people to express themselves, communicate, and solve problems using ever-wider combinations of types of thought, such as music, dance, imagery, words, and numbers.

Staff Competencies

The school district computers-in-education plan should identify the staff competencies that will be required to implement the district-developed computer literacy integration matrix. These competencies may not be the same for all teachers. Competencies might be chosen from the following list.

Instructional Tool. The teacher will be able to use computer software to

- provide reinforcement,
- individualize instruction,
- motivate students,
- involve students in simulated situations,

- involve students in problem solving,
- reward students for specific behavior,
- have students organize and store information,
- have students analyze and synthesize information,
- control and manipulate instructional equipment,
- assist in developing student communication skills,
- have students retrieve information, and
- help provide demonstrations for students.

Management Tool. The teacher will be able to use computer software for
- test scoring and data analysis,
- materials generation,
- management of instruction,
- information retrieval, and
- word processing of material.

Facilities/Resources

Having surveyed the district's needs and having established program goals for the use of computers in instruction, the committee should next identify the facilities/resources needed to achieve desired goals. Specifically, committee members should consider
- hardware and peripherals,
- hardware location,
- space, and
- software.

Hardware Selection

A list of the district's present and future needs, correlated with the capabilities of the computer, is a good place to begin the process of hardware selection. When making a needs assessment, school district staff should remember that most computers can only use the programs specifically designed for that make or type of computer. So, if computers are to be used primarily for classroom instruction, available instructional software should be reviewed before hardware is chosen. A hardware evaluation work sheet appears in Appendix C.

Hardware Location

Computers should be located at places in buildings where they will be most accessible to the largest number of users. A variety of options for computer placement are available.

Computers should be located . . . where they will be most accessible to the largest number of users.

Man attempts through technology to overcome his shortcomings and his vulnerability by extending his limited capacities. He thus enhances his power, which in turn often enables him to survive, and, on occasion, even to thrive.
—*N. Bruce Hannay and Robert McGiam,* The Anatomy of Modern Technology

Independent Study. A computer for student use can be placed in the instructional media center (IMC), an independent study area, or a lab area.

Department/Teacher Use. Some secondary school departments or elementary schools may need access to a computer system for teacher exploration/experimentation, the authoring of computer-assisted instruction (CAI) programs, testing and evaluation, and so on. Others, such as guidance department staff, may utilize a computer in work with students.

The "Traveler." A mobile computer system can be made available for checkout to individual classrooms conducting CAI or computer education units.

Permanent Assignment. The curriculum may dictate that a computer be permanently assigned to a specific classroom in some cases.

Computer Lab. This is an area housing a sufficient number of computers so that each student or every two students can have immediate access to a computer. The computer lab can be designed for single-discipline or multidiscipline use.

Networked Classroom Computer Lab. Such a lab has computers networked to share software and peripherals.

Instructional/Management Computer. Staff use this computer for management information system applications.

A combination of options may be chosen. Location choices should be based on intended use of the hardware and on the need to provide the best possible access for students.

Space

Among issues to be reviewed when considering specific spaces or locations for computer hardware are

- ease and flexibility of access,
- supervision requirements,
- power requirements,
- cable and telephone access,
- human comfort and health factors relating to computer use (ergonomics),
- handicapped access,
- security considerations, and
- classroom space for individualized computer interaction.

Software

For computers to be used successfully in instruction, adequate and appropriate software resources must be available. Planning for instructional resource support should include the following components:

- identification of needs,
- identification, review, and evaluation of materials,
- acquisition of materials, and
- management of resources—storage, cataloging, and dissemination.

These planning issues are dealt with in detail in Section 4.

Budget Considerations

In addition to facilities and resources, the district plan should also address staffing questions such as

- leadership and coordination needs at both the district and building levels;
- staff support needs; and
- instructional delivery requirements—who will provide instruction to students—for the various areas of the computer literacy integration matrix:
  - —all classroom teachers,
  - —select classroom teachers with special training,
  - —a computer specialist.

The budget is developed in response to the implementation plan and should adequately reflect the needs identified in the plan.

Before a district computer education plan is finalized it should be evaluated by the computers-in-education advisory committee. The following questions may be used in this process.

- Does the computer education plan fit in adequately with the district curriculum and educational philosophy?
- Does the plan clarify for students, staff, and community the philosophy, mission, and goals of computer education in the district?
- Does the plan include a process for determining whether what is being offered is important, worthwhile, and accepted by the various groups in the district?
- Is the plan realistic in light of resources available, and does it have a good chance of success?
- Does the written plan allow for
  - —assessment of needs?
  - —planning?
  - —implementation?
  - —evaluation?
  - —reporting to the public?
- Does the plan allow for review and revision as some goals are achieved and new needs are identified?

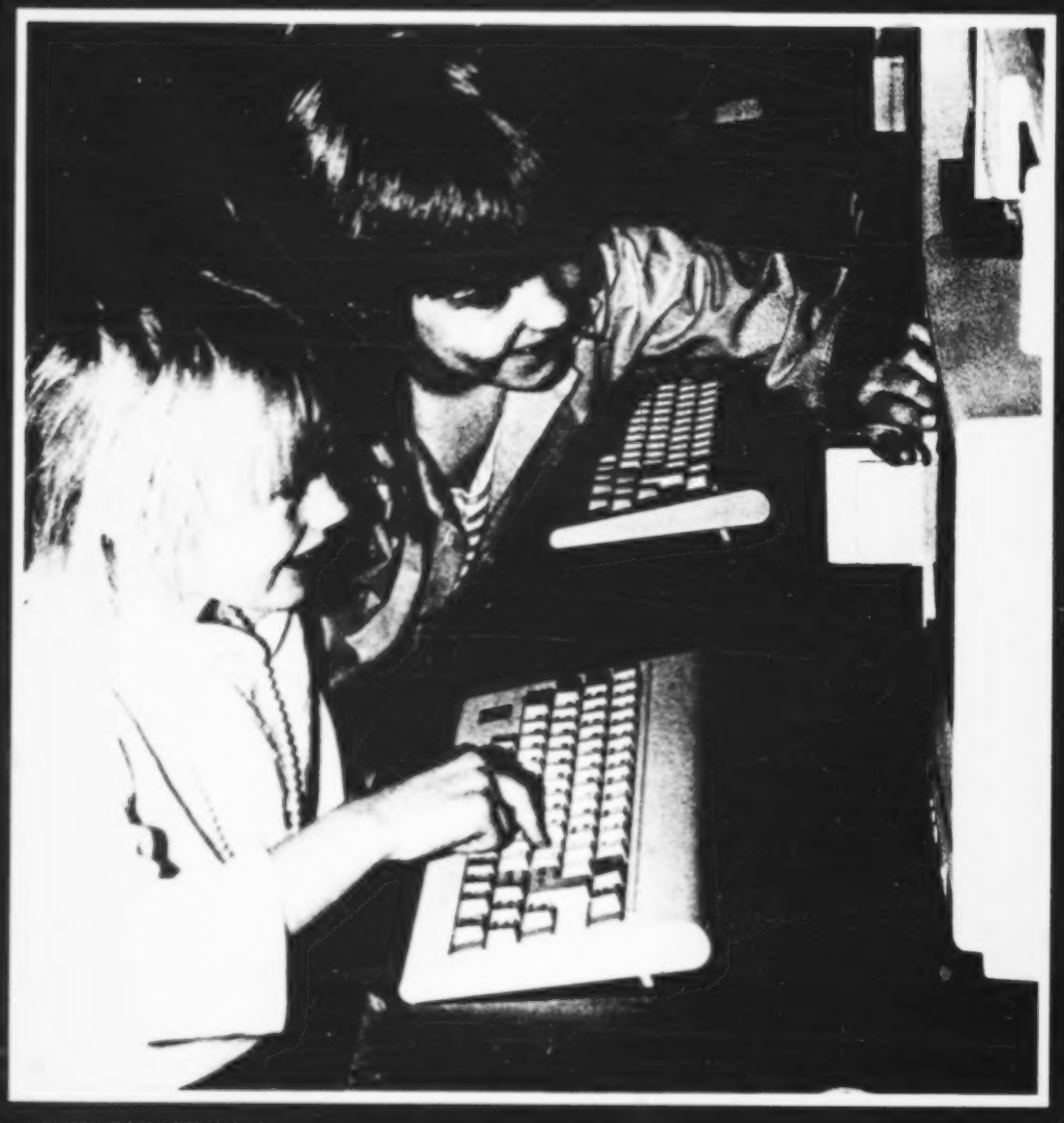
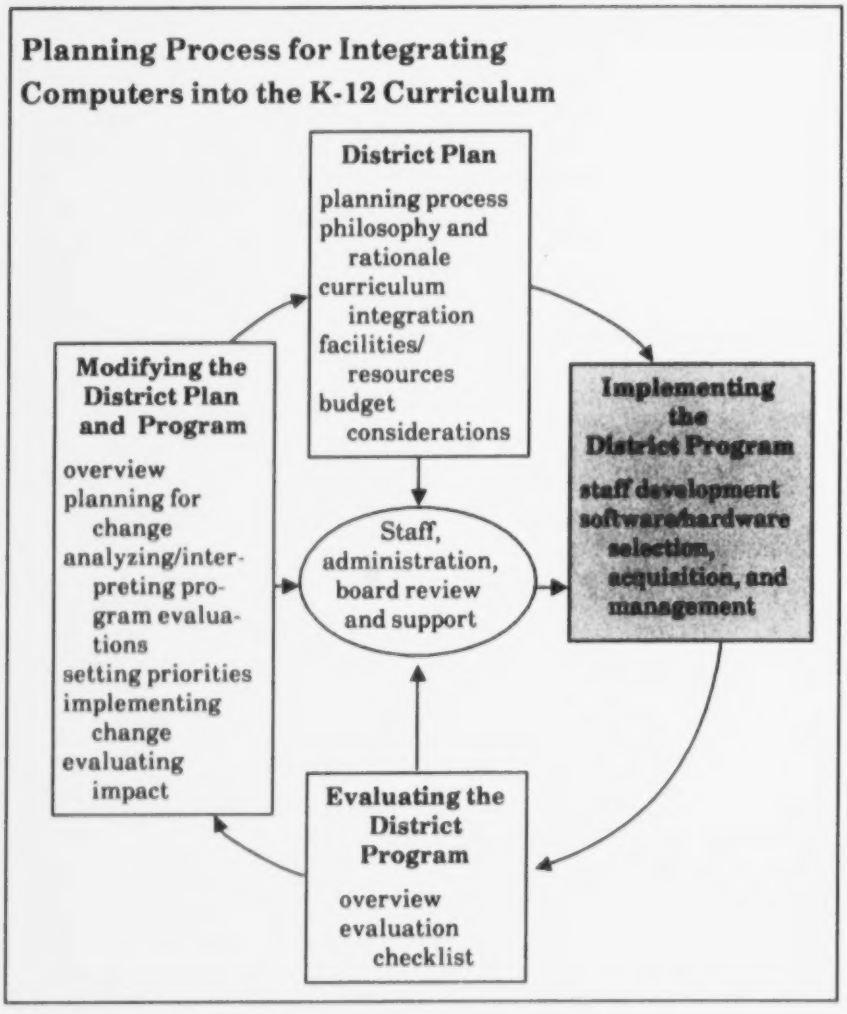


Figure 7



Staff Development

Rationale

Knowledge of the computer is basic to an understanding of the full range of procedures that may be applied to organizing information and solving problems in many fields. Integrating of computer technology as an effective instructional tool in many disciplines can help students achieve a level of competency in many computer education areas. Careful revision and adaptation of curriculums in various disciplines to build the necessary skills for an information-age society will also lead to student achievement in computer education.

Staff development programs are the most important vehicles for integrating use of computers and other current technologies into school district programs. Teachers and administrators, old and new, have a variety of fears, hopes, and ideas about the uses of computers and how they and their students will be affected by them. Because instructional computing is very new and may require new skills, some teachers may be intimidated by computers and reluctant to use them in their classrooms. Other teachers may naively feel the computer is just another piece of equipment, and that all they have to learn to do is plug in some software and let the students go. The truth lies somewhere between these two extremes. The enthusiastic and uniform acceptance of computers in a district will depend on the presence of a well-organized inservice program that provides a supportive atmosphere for all involved.

Teachers and administrators have the ability to make decisions about computer utilization with insight, knowledge, and experience. The primary goal of a staff development program in computer education is to enable teachers to use the computer creatively in instruction.

Computers, computer software, videodiscs, teaching machines, and other technologies are becoming increasingly available for school use. Many schools are incorporating these support systems in their educational programs. With this proliferation of computers, related technologies, and various software, there is an increasing need for all educators to understand not only the mechanics of the materials and equipment, but the assumptions implicit in their use. If educators lack this understanding, the new technologies may become ends in themselves.

—Association for Supervision and Curriculum Development

Content and Learning Outcomes

School districts have a responsibility to provide development opportunities through which staff can acquire a functional knowledge of computers and their applications and learn how to integrate these into the classroom learning environment. Such opportunities cannot be provided with a one-time inservice. They must be continuous and ongoing. As current technologies continue to evolve, so must the knowledge base of all teachers. The widespread impact of computer technology requires the participation of all staff, not just those with an interest in computers.

Staff development opportunities should be district supported, ongoing, and designed to meet the varying needs of teachers in all disciplines and levels of instruction. They should be structured to address the following three areas of competence.

Introductory Concepts

Staff development programs should give district personnel a general understanding of social and economic effects of computers and how technology is influencing the changes occurring in society today.

Basic knowledge of how computers work, common computer terminology, and various applications of computers should be taught, including how computers are used in everyday living, transportation, communication, merchandising, banking, business, and manufacturing.

District staff should gain an understanding of the computer as a tool in computer-aided learning and discuss evaluation of software and classroom implementation strategies.

Staff development activities should provide exposure to a programming language like Logo or BASIC and the writing of simple computer programs.

General Applications

District staff should gain from inservice training the ability to use application software such as word processing programs, databases, and spreadsheets.

They should also develop a general understanding of computer applications in various occupations related to content areas.

Do you know what it is like to fiddle around ineptly with a piece of electronic gear before a class of 17-year-olds whose bedrooms resemble the testing laboratories at RCA?
—Pat Daly, Vice President, American Federation of Teachers

Specific Content-Area Applications

Teachers should be able to gain from staff development activities

- an understanding of computer applications in occupations related to a specific content area,
- a working knowledge of computer applications which may be used in instruction for a specific content area,
- experience using the computer in all aspects of computer-aided learning, and
- the ability to plan, implement, and evaluate activities which integrate the computer into classroom instruction.

It is recommended that teachers become competent in all three of the above areas, with the introductory concepts being prerequisite to the other two sets of concepts. Instruction in the introductory concepts will require a minimum of 15 to 20 contact hours and must include "hands-on" experience. Competence in the general applications area should not be seen as a prerequisite to learning about specific content-area applications.

Training must include discussion of ways to effect change in the educational environment. Topics such as learning how to restructure curricular content to accommodate current and future technologies, making methodology changes to accommodate the use of computers within existing curricula, and determining the uses of computers for classroom management must be addressed. Activities must help all staff integrate computers appropriately into the classroom in a manner that builds on the successes of existing programs.

Organization of Staff Development Programs

Computer-oriented staff development programs must be created to accommodate the unique needs of individual school districts while maximizing their resources. They must be creatively designed and effectively communicated if the retraining challenges presented by information-age technologies are to be met. As indicated, these programs should address three areas of competence: introductory concepts, general applications, and specific content-area applications.

In addition, school districts should consider a variety of staff development activities to meet individual, small-group, or large-group needs. Appropriate and cost-effective methods should be used to address the particular needs identified. Examples which address various levels of needs follow.

Individual Needs

- Attendance at conferences
- Visitations to other districts
- Consultation with resource people
- Workshop participation
- College or university courses
- Independent work

Small-Group Needs

- Attendance at conferences
- Visitations to other districts
- Meetings with resource people
- Workshop participation
- College or university courses
- Summer workshops

Large-Group Needs

- Inservice days
- Summer workshops
- In-district college or university courses

Why should educators make the considerable commitment of time and energy required to acquire a functional knowledge of computer technology? Motivation and interest are key ingredients in all education programs. In many cases, professional pride and interest, as well as concern for students, are enough to insure the success of the comprehensive staff development effort needed. However, other incentives must be provided. The following is a list of incentives that have been used successfully in Wisconsin schools.

- Stipends
- Release time
- Conference attendance
- Visits to other schools/facilities
- Board credit
- College or university credit
- CEUs (continuing education units)
- Hardware access
- Software budget increases
- Other media
- Resume enhancement

I don't shake with fear when I enter a reading room, so why should I be afraid of computers when they perform the same functions as a library? . . .With a book tucked in one hand, and a computer shoved under my elbow, I will march, not sidle, shudder or quake, into the twenty-first century.
—Ray Bradbury

Instructional Management

The way the computer is used in the educational setting is determined by the amount of hardware available, the type of software used, and the school district philosophy. Various techniques for using computers in the

curriculum may be considered. District planners should realize that the size of the group that can effectively work on one computer simultaneously depends on the software program being used and desired objectives. Groups of three or four students may be very productive if a software program is designed for active involvement of all participants. If the program is designed for one or two students, it is important that the other students remain involved in other learning activities while they wait for their turn on the computer.

Individual Instruction. The computer is used as a supplement to a regular classroom program with enrichment or remedial work. Students are assigned computer programs which fit their achievement levels after the material has been presented to the entire class. This is an effective way to meet individual needs, but it does require software that can be used at many different levels.

Large-Group Instruction. The computer is used as a demonstration or class discussion tool. This allows the introduction of special topics and gives the teacher the ability to control input in a demonstration in order to achieve an objective and to make certain that all significant points are covered.

Small-Group Instruction. The computer is used as an integral part of daily classroom presentation. The instruction for the day may include student use of a particular computer program with a set educational objective. Students in small groups may cooperate in the decision-making process, or the program may be used on an individual basis.

In computer-aided learning, the computer does not dictate the curriculum. Computers do certain things well and fit into certain established curriculums. Educators should determine their curriculum first and then consider how computers can further the instructional objectives and support the activities of that curriculum.

Many educational innovations have failed to have the impact on education originally hoped for because districts have failed to provide adequate training opportunities for instructional staff. A strong, innovative staff development program is needed to assure that teachers can meet students' information-age educational needs.

Software/Hardware Selection, Acquisition, and Management

Software Selection and Acquisition

To utilize the full potential of any computer system, school district staff must evaluate and select software carefully. The process of evaluat-

ing and selecting computer software should be like that used to review any instructional media. The main considerations should be those listed below.

Educational Content

- Does it fit the grade level intended; what is the readability level?
- Is the content accurate?
- Is the software program keyed to some of the instructional objectives of the course for which it is intended?
- Is it free of sex and ethnic biases?
- Are there adequate examples for the student to follow?
- Is there a logical sequence to the presentation?
- Is the program free of spelling, grammatical, and punctuation errors?
- Has course software been classroom and student validated?

Computers are fast, accurate, and stupid—man is slow, inaccurate, and brilliant. The marriage of the two is a force beyond comprehension.
—Unknown

Presentation Format

- Does the software call for an appropriate use of the computer?
- Is the reinforcement used in the software appropriate? For example,
  - — is it immediate and not delayed?
  - — is sound used in a positive way?
  - — are visuals interesting?
- Are the directions clear and precise?
- Does spacing make the screen easily readable?
- Is the program interesting and not repetitious or boring?
- Is there a screen delay which is disconcerting?
- Does the program use upper- and lower-case print?

Interactivity

- Does this program make creative use of the computer?
- Are responses personalized with the student's name?
- Are cues and prompts clear and placed where they are needed?
- Is help readily available and accessible?
- Are the pace and sequence well controlled?

Teacher Use

- Does the printed documentation include
  - — instructional objectives?
  - — grade-level designation?
  - — clear directions for use?
  - — suggestions for related activities?
  - — validation information?
- Is the package appropriate for educational use?
- Is record keeping possible?
- Is it possible to make or obtain a backup copy?

Software Management

All computer software a school district purchases should be cataloged and processed (inventoried) in the same manner as all other media in the district, no matter what source of funding is used for purchase. This is important for a number of reasons.

It is essential that a school district maintain an overall inventory of computer software to avoid unnecessary duplication.

Cost Effectiveness. It is essential that a school district maintain an overall inventory of computer software to avoid unnecessary duplication. Multiple copies of software may very well be necessary, but duplication should be a specific decision and not a "happening."

Different companies market software programs with the same or similar titles at vastly different prices. One person in a school district—ideally the district media director—should have the responsibility for checking purchase requests against the district's inventory to avoid unnecessary duplication.

All software owned by a district should have district ownership labels and other necessary markings applied in a consistent manner. This can help avoid theft and loss and insure easy inventory at the end of the school year.

Best Overall Use of Resources. Some software can easily be shared between buildings or between teachers in a building. This software is the type that is used for a short term in a classroom, as are certain sound filmstrips or ITV (instructional television) programs. Other computer software will have to be checked out on permanent loan to a specific department, building, teacher, or administrator or to the program for which it was purchased. The district media director and building media specialist, along with those requesting the software, should make the decision as to where software will be housed, but it should all be centrally inventoried to facilitate better overall use of district resources. *The primary concern is not so much where the software is housed but that it first be centrally inventoried.*

Collection Growth. While school district software collections may be limited at present, they are likely to grow rapidly in the next few years. This potential proliferation of software makes it even more important that inventories be kept from the time when computer software collection development in a district first begins. An inventory makes it possible for buildings or individuals who request software already owned by the district to discuss its merits and disadvantages with those who have already used it, have an opportunity for hands-on experience, and make better-informed judgments.

Software Copyright Issues

The copyright law of the United States is designed to protect the creative work of authors. Educators should be aware of the legal and ethical issues implicit in copyright laws and publisher license agreements, par-

ticularly as they relate to computer software. Educators must also accept responsibility for enforcing the copyright law in the school setting. Budget constraints or ignorance of the law do not excuse illegal use of software in a court of law.

Public Law 96-517, which the U.S. Congress passed in December 1980, amends a common copyright law to grant the owner of a particular computer program the right to copy it if, and only if, (1) such a copy is "an essential step in the utilization of the program in conjunction with a machine," or (2) the copy is for archival purposes, that is to serve as a backup in case the original is lost or destroyed. Together, these exemptions are known as the "fair use" doctrine.

Some copying, then, is perfectly legal; the law as it now stands adequately responds to the need for backup copies to protect the original investment in software. But that is where the line is drawn. *A school may not purchase one copyrighted computer program and reproduce it in quantity for use with several computer systems without the express permission of the copyright owner.* To do so would be a violation of federal law.

Without a license that permits the booting of one disk into multiple machines in sequence, school districts that do this are probably in violation of the copyright law. The term *probably* is used here because without clear interpretation of this issue in a court of law it is not possible to say for certain. The law is designed to protect the copyright holder from loss of sales. By booting the same disk into ten computers one after another, school district staff are inhibiting sales. Fortunately, more and more computer software producers are offering special lab packs of software at greatly reduced prices, or they offer a licensing agreement that permits use of software on more than one computer at a time so that schools can choose legal but affordable methods of operating multiple computers with the same software package.

Without a license that permits the booting of one disk into multiple machines in sequence, school districts that do this are probably in violation of the copyright law.

Copyright violations can also occur in networking. School staff are probably violating the copyright law if they download a program to a number of computers through a networking system, unless the school has a network license for that software. Again, more and more instructional software producers are offering this type of license.

Schools can minimize both deliberate and innocent violations of the copyright law by adopting a district policy on software copyright, making teachers and students aware of the law, and following up on violations of the law. There is a basic issue at stake which seems to often be missed—teachers and administrators act as role models for students, and blatant, illegal copying of computer software is against the law.

. . . teachers and administrators act as role models for students, and blatant, illegal copying of computer software is against the law.

If educators duplicate software that is copyrighted, it is possible that the commercial producers of educational software will not be able to recoup their original investments; and if the profits from writing and marketing educational software dry up, so may the potential supply of quality software.

Hardware Selection and Acquisition

The deliberate absence of a computer policy is itself a policy with major risks. We conclude that no school should buy computers, or any other expensive piece of hardware, until key questions have been asked—and answered. Why is this purchase being made? Is the software as good as the equipment? What educational objectives will be served? Which students will use the new equipment, when, and why? Are teachers able to fit the technology and the software into the curriculum?
—*Ernest L. Boyer*, High School: A Report on Secondary Education in America

Making a list of the school district's present and future needs, in line with the capabilities of the computer, is a good way to begin the hardware selection process. When making this needs assessment, district personnel should remember that in most cases a computer can only use the programs designed to run on that particular make or model. So if classroom instruction is the main use intended for a computer, district staff must investigate the available software before making a hardware decision. Below are questions to be asked in the course of the hardware selection process.

- What present and future instructional uses or applications are planned for the hardware?
- What *software* is available for the uses planned for the computer? How good is the software, and what do reviews say about it?
- What are the immediate *costs* of the equipment planned for purchase? What are the costs of expanding or upgrading the system? How about interfaces and connections?
- What *peripherals* are available to communicate with the computer or to increase its usefulness—for example, printers, disc drives, light pens, graphics tablets, game controllers, modems?
- What is the *memory* capacity of the computer? Does it match the memory requirements of the desired software? How much does additional memory cost? What is the maximum amount of memory the computer can support?
- What *languages* come with the computer? What other languages are available and how expensive is each additional one?
- Is the *video display* terminal attached to the keyboard or is it separate? Can additional monitors be attached to the computer?
- Is the *keyboard* laid out in standard typewriter style? What is the feel of the keyboard? Does the keyboard have special keys for specific purposes, for example, graphics, data entry, text editing? Are there programmable keys?
- Does the computer have *special features* which may be needed, such as graphics capabilities, sound and music, and so on? If not, can they be added?
- What *documentation* is available on using the computer? Is it written for the novice or only for the technically oriented?
- Is the equipment *user friendly*? Is the computer easy to use?
- What are the *physical dimensions* of the computer? How much does it weigh? Can it be easily transported between classrooms?
- What consulting services are available to the district for the hardware being considered?

A hardware evaluation work sheet appears in Appendix C.

Maintenance

School district personnel should consider a number of factors that will affect maintenance of any hardware they purchase.

- What warranties are available?
- Can a unit be serviced where it is purchased?
- Is on-site servicing available?
- Can local technicians make necessary repairs?
- Can the unit be updated for the next year to reflect refinements?
- How long does it take for service, including transportation to and from the service facility?
- What are service charges, including the costs of transportation?
- Are agencies such as CESAs (cooperative educational service agencies) providing repair service for the hardware being considered?

Security

In an attempt to make computer equipment as accessible as possible to all potential users, schools should adopt security policies and procedures and include plans for checking out equipment to teachers for home use.

Computer hardware should be inventoried and labeled in the same manner as all other district or building audiovisual hardware and equipment. Two of the easiest and most cost-effective means of deterring theft, aiding insurance claims, and reclaiming stolen property are making ownership obvious and keeping up-to-date, readily accessible inventories.

As schools become mass consumers of computer equipment, they also become lucrative targets for theft. Theft or vandalism of equipment can mean severe loss of money, staff time, and program "up" time.

As schools become mass consumers of computer equipment, they also become lucrative targets for theft.

Safety and Ergonomics

Insuring that computers are used safely and comfortably involves consideration of a wide variety of factors, including reduction of glare on the monitor screen, securing tables of appropriate height for comfortable keyboard use, sensitivity to the length of a work session, and awareness of the debate over potential health hazards.

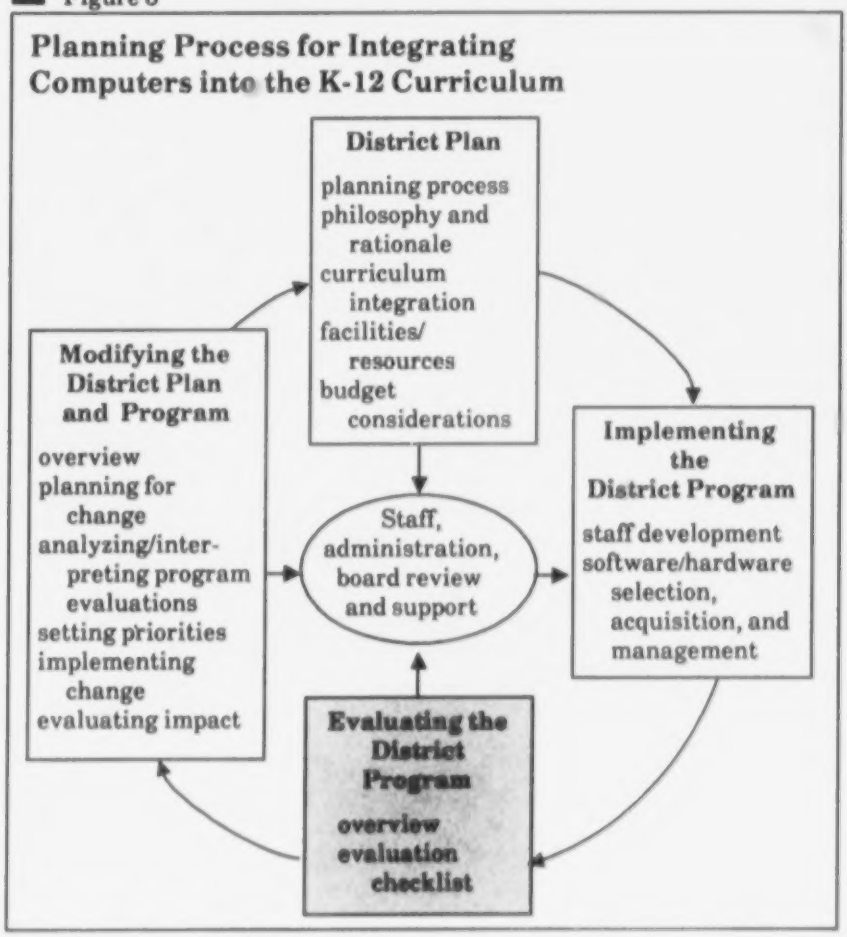
In-depth discussion of such considerations is beyond the scope of this curriculum guide.

Overview

Computers can enable students to do and make and act. Let's not settle for mere warehousing. Knowledge is not a spectator sport!"
—Thomas C. O'Brien

Successful computer education programs show visible evidence that computers are being integrated into the life and learning of the classroom, rather than being limited to use during a small amount of directed class time. Where computers have been effective, the teacher has often arranged for computers to be accessible to students on a flexible basis so that they may serve as resources in a wide range of subject areas, as well as teaching computer literacy for its own sake.

Figure 8



Evaluation Checklist

The evaluation checklist provided in this section is based on all aspects of the district plan outlined in this guide.

Table 7

Evaluation Checklist

Criteria	Degree of Implementation: None	25%	50%	75%	Complete	Required Action/Comments
District Plan						
1. The district has a planned program for integrating computers and computer education into the K-12 curriculum (hereinafter referred to as *the plan*).	0	1	2	3	4	
2. A written statement of the plan is available.	0	1	2	3	4	
3. The plan is reviewed and updated on a regular basis (at least once a year).	0	1	2	3	4	
4. The plan addresses the following components:						
• program philosophy and rationale,	0	1	2	3	4	
• program goals,	0	1	2	3	4	
• curriculum integration,	0	1	2	3	4	
• student competencies/ achievement,	0	1	2	3	4	
• scope and sequence,	0	1	2	3	4	
• responsibility for the program,	0	1	2	3	4	
• staff competencies,	0	1	2	3	4	
• staff development,	0	1	2	3	4	
• hardware/resource/ facility requirements,	0	1	2	3	4	
• implementation schedule/budget,	0	1	2	3	4	
• review, evaluation, and modification.	0	1	2	3	4	
District Organization/ Implementation						
1. One person has been designated to assume major responsibility for districtwide planning and coordination of the computers-in-education program.	0	1	2	3	4	

Criteria	Degree of Implementation: None	25%	50%	75%	Complete	Required Action/Comments
District Organization/ Implementation (cont.)						
2. The computer coordinator is provided with time and district support to carry out duties of the position.	0	1	2	3	4	
3. A computers-in-education committee has been organized to assist the computer coordinator with the planning and implementation of the district plan.	0	1	2	3	4	
4. The computers-in-education committee meets on a regular basis.	0	1	2	3	4	
5. Opportunities for training/ inservice education are regularly provided to the computer coordinator and members of the computers-in-education committee.	0	1	2	3	4	
6. The implementation of the district plan is on schedule.	0	1	2	3	4	
7. A monitoring system is used to assess the effectiveness of the computer program in light of established objectives/student outcomes.	0	1	2	3	4	
8. Computer literacy competencies for all students have been defined.	0	1	2	3	4	
9. Computer literacy competencies are being taught to all students at appropriate levels.	0	1	2	3	4	

Criteria	Degree of Implementation None	25%	50%	75%	Complete	Required Action/Comments
District Organization/ Implementation (cont.)						
10. Budget commitments to the program are forthcoming and on schedule.	0	1	2	3	4	
11. Within the district, there is equity in the program from school to school.	0	1	2	3	4	
12. Building responsibilities for the use of computers in instruction have been defined and delineated for all staff.	0	1	2	3	4	
Staff Development						
1. Staff development needs are assessed on a regular basis.	0	1	2	3	4	
2. Opportunities for inservice training in computer literacy are available to all staff.	0	1	2	3	4	
3. Teachers are involved in the development of inservice training programs.	0	1	2	3	4	
4. Teachers are required by the district to be computer literate.	0	1	2	3	4	
5. There is a formal staff development program for all teachers and support personnel.	0	1	2	3	4	
6. The staff development program/activities are regularly evaluated by the computer coordinator and the computers-in-education committee.	0	1	2	3	4	

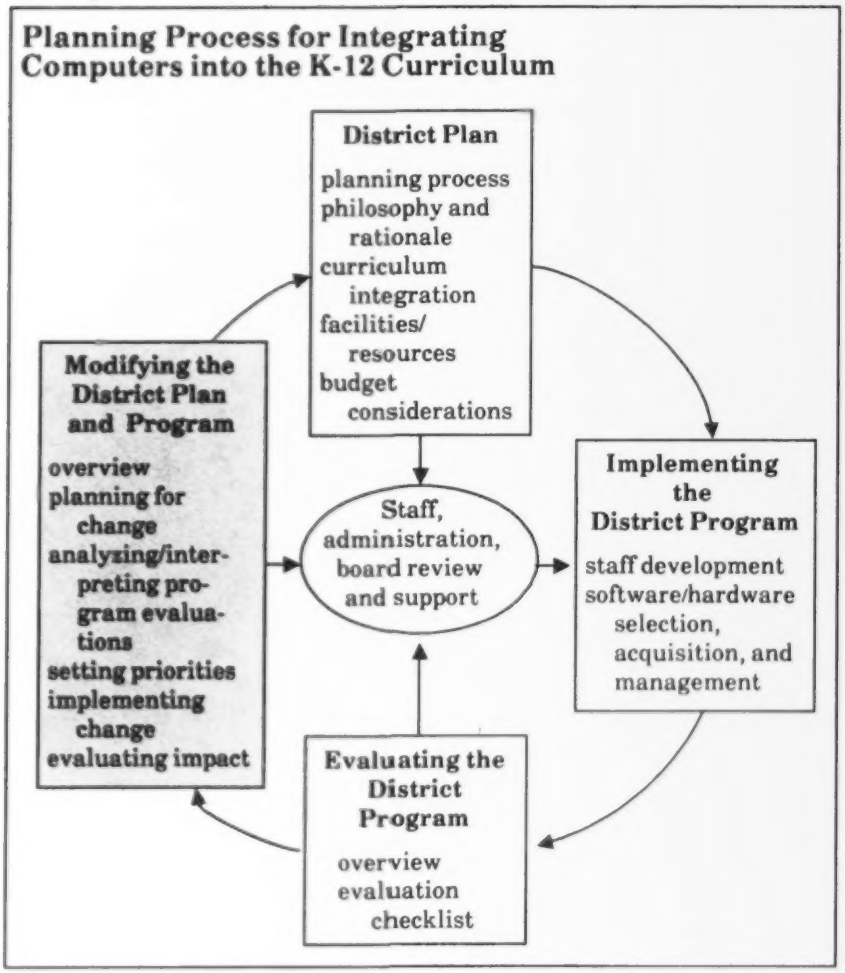
Criteria	Degree of Implementation None	25%	50%	75%	Complete	Required Action/Comments
Computer Facilities						
1. There is a district plan/ strategy for the deployment of computers in the district and within individual buildings.	0	1	2	3	4	
2. There is a district plan for the implementation, curricular use, and staffing of computer labs at all levels.	0	1	2	3	4	
Computer Hardware						
1. There is a hardware selection and acquisition process in place which employs specific criteria.	0	1	2	3	4	
2. Computer systems (hardware and peripherals) are matched to the needs of the various curricular areas.	0	1	2	3	4	
3. There is an up-to-date district inventory of all computer hardware.	0	1	2	3	4	
4. Provisions are made for						
• equipment security,	0	1	2	3	4	
• insurance,	0	1	2	3	4	
• maintenance and repair,	0	1	2	3	4	
• upgrading equipment,	0	1	2	3	4	
• student/staff use (policies),	0	1	2	3	4	
• power/telecommunications access,	0	1	2	3	4	
• handicapped access,	0	1	2	3	4	
• ergonomics,	0	1	2	3	4	
• preventive maintenance,	0	1	2	3	4	
• ease and flexibility of access, and	0	1	2	3	4	
• supervision/safety requirements.	0	1	2	3	4	

Criteria	Degree of Implementation					Required Action/Comments
	None	25%	50%	75%	Complete	
Computer Software						
1. Software is evaluated and selected for purchase based on principles found in the district's instructional materials selection policy.	0	1	2	3	4	
2. Software is purchased to support the board-approved curriculum of the district.	0	1	2	3	4	
3. There is an up-to-date inventory of all district-owned computer software.	0	1	2	3	4	
4. There is a district policy on software copying, backup copies, and software piracy.	0	1	2	3	4	
5. Appropriate support materials—workbooks, documentation, and so on—are provided for teachers and students.	0	1	2	3	4	
6. Current guides, journals, and other resources which evaluate software are available and accessible within the district.	0	1	2	3	4	
7. Ongoing funds are provided for the purchase of new and appropriate computer software.	0	1	2	3	4	
Curriculum Integration						
1. The district's definition of computer literacy is disseminated to and understood by all staff.	0	1	2	3	4	

Criteria	Degree of Implementation: None	25%	50%	75%	Complete	Required Action/Comments
Curriculum Integration (cont.)						
2. The following computer literacy competencies are expected of all students as part of a K-12 curriculum sequence:						
• history and social impact of computers,	0	1	2	3	4	
• computer concepts and operation,	0	1	2	3	4	
• keyboarding knowledge,	0	1	2	3	4	
• an introduction to programming,	0	1	2	3	4	
• text/word processing,	0	1	2	3	4	
• database management,	0	1	2	3	4	
• electronic spreadsheets,	0	1	2	3	4	
• computer graphics,	0	1	2	3	4	
• telecommunications,	0	1	2	3	4	
• simulations, and	0	1	2	3	4	
• use of integrated software.	0	1	2	3	4	
3. The teaching of computer literacy competencies is integrated into the total school curriculum.	0	1	2	3	4	
4. The district's written curriculum guides for the various academic disciplines denote/integrate computer competencies which students must utilize in the various courses/disciplines:	0	1	2	3	4	
• language arts	0	1	2	3	4	
• social studies	0	1	2	3	4	
• science	0	1	2	3	4	
• mathematics	0	1	2	3	4	

Criteria	Degree of Implementation					Required Action/Comments
	None	25%	50%	75%	Com-plete	
Curriculum Integration (cont.)						
• art,	0	1	2	3	4	
• music,	0	1	2	3	4	
• foreign languages,	0	1	2	3	4	
• technology education,	0	1	2	3	4	
• home economics,	0	1	2	3	4	
• business education,	0	1	2	3	4	
• marketing,	0	1	2	3	4	
• agriculture,	0	1	2	3	4	
• health/physical education, and	0	1	2	3	4	
• computer science.						
5. The integration of computers into the various curricular areas is reviewed on a regular basis by appropriate personnel.	0	1	2	3	4	

Figure 9



Overview

All curriculum developers fact a task that is never completed.

All curriculum developers face a task that is never completed. To say that the goal may never be reached is not to say, however, that one should shrink from working toward it.

Curriculum improvement efforts, then, must be coordinated, comprehensive and constant. A number of curriculum development models are available, and almost all point out that any program improvement effort which ignores the direct input and commitment of the educational practitioner is fated not to succeed.

An organized approach is necessary if a school district's computer plan and computer literacy/instructional computing curriculum are to be eval-

uated and if changes, whether subtle or substantive, are to occur. Flexibility is essential if change is to be accomplished easily, and flexible procedures are no more important than flexible minds. The ever-developing nature of technology dictates that planning must be flexible and planners able to modify progress and curriculum to incorporate technological advances and new applications. Those who develop a computer implementation plan not only must be *responsible* for dealing with technology, but also must create a responsive plan that provides for incorporating new strategies and addressing new needs.

Flexibility is essential if change is to be accomplished easily, and flexible procedures are no more important than flexible minds.

The evaluation component developed as an integral part of each district plan will serve as an invaluable tool for reviewing the plan and curriculum implementation efforts. Gathering the data and measuring their impact constitute one important step in planning for modifications. Other evaluation techniques can also be used, including hiring outside evaluation consultants; participating in a formalized evaluation program which utilizes a self-evaluation component and on-site team visits; and using checklists/rating scales and other evaluation instruments provided by software and hardware vendors, curriculum evaluation textbooks, the Wisconsin Department of Public Instruction, and others.

Once evaluation is completed, how are district staff to modify the computers-in-education program to insure continued effectiveness? A variety of modification strategies can, of course, be adopted. One involves the use of a program improvement plan. The program improvement plan involves viewing modification needs from at least three perspectives.

- What *people* are involved in making the change?
- What *situations* prompted the decision to change?
- When did the *impact* necessitating change occur?

The answers to these three questions have direct implications for, and should be carefully considered during, the modification process.

Modifying a school district's curriculum plan is an integrated process including five steps, each leading to the one that follows. To begin the process at any middle step will severely limit overall effectiveness of efforts to implement desired program modifications. The five steps are listed below.

- Planning for changes
- Analyzing/interpreting program evaluations
- Setting priorities
- Implementing changes
- Evaluating impact

Systematic planning for changes in the district computer plan and curriculum calls for the involvement of many different people to maximize program effectiveness. When the district computer coordinator sets a positive tone and displays an open attitude toward the change process, the entire district computers-in-education committee is likely to expect changes and accept the need to plan to incorporate them.

Planning for Change

Education is a problem of getting our bearings, of developing orientation, of discovering in what direction to go and how to get there.
—Edgar Dale

Annual review of the district computer plan should involve use of one or more evaluation strategies. Planning for the modifications called for by the review may include all of the following activities:

- Utilize plan evaluation checklist.
- Have district computer coordinator coordinate evaluation findings.
- Have district computer coordinator present evaluation findings to the committee.
- Have district computer coordinator and computers-in-education committee review recommendations.
- Establish priorities for change.
- Develop program improvement plan.
- Implement changes outlined in program improvement plan.
- Evaluate impact of implementation.

Analyzing/Interpreting Program Evaluations

How can evaluation findings be translated into action for improvement?

The district computer coordinator may have to call several meetings to analyze and interpret evaluation findings. The committee should consider program as well as management implications, look for strengths as well as weaknesses and recommendations for improvement, and categorize potential program improvements by area. The committee must try to identify patterns of problems, student needs, and other factors brought out by the evaluations. Asking questions implied by the categories of improvements needed is also essential. What computer education strategies have been effective? What elements have contributed to that success? What new ideas about dealing with problem areas have surfaced? How can evaluation findings be translated into action for improvement?

Setting Priorities

A separate committee meeting should be set up after evaluation findings have been thoroughly discussed, grouped, and interpreted, in order to establish improvement priorities. The school district's computer coordinator should lead this meeting, attempting to take into account profes-

sional goals of individual staff as well as overall district goals in the priority-setting process.

After briefly screening the analysis of evaluation findings, committee members should develop a list of criteria for decision making, among them

- facility needs,
- hardware needs,
- staff development needs,
- software needs,
- equity concerns,
- curricular integration,
- budgetary considerations, and
- other concerns.

The role of the teacher is to let children experiment, to put the burden of learning in their laps, and to make them thinkers rather than memory bins.
—Sunburst Software

Using the developed criteria, each committee member should then select three programs that he/she believes are most in need of action, based on the overall needs of the district. Three points are given to the most important one, two points to the second in importance, and one point to the third. The district computer coordinator tabulates the priority ratings of all members to determine the most important program improvement categories. This process can be repeated if necessary to determine priorities for write-in categories.

Using the first two work sheets in Appendix D, the group as a whole can then decide on maintenance strategies for strengths and suggested solutions for weaknesses. The third work sheet in Appendix D can be used to develop a program improvement plan. The committee must list all selected program improvement categories in descending consensus order, noting as well the person(s) responsible for carrying out changes, facility/resource needs, and completion dates.

Implementing Change

All of the previous activities have prepared committee members for the action phase—actual implementation of changes in program plan and curriculum. To facilitate changes, good communication among school staff is absolutely essential. The district computing coordinator should distribute and discuss the program improvement plan with all staff involved. Consideration of potential "roadblocks" is vital. Everyone should be given a full picture of the comprehensive action plan. Adjustments in the completion dates may be necessary, depending on staff response.

To facilitate changes, good communication among school staff is essential.

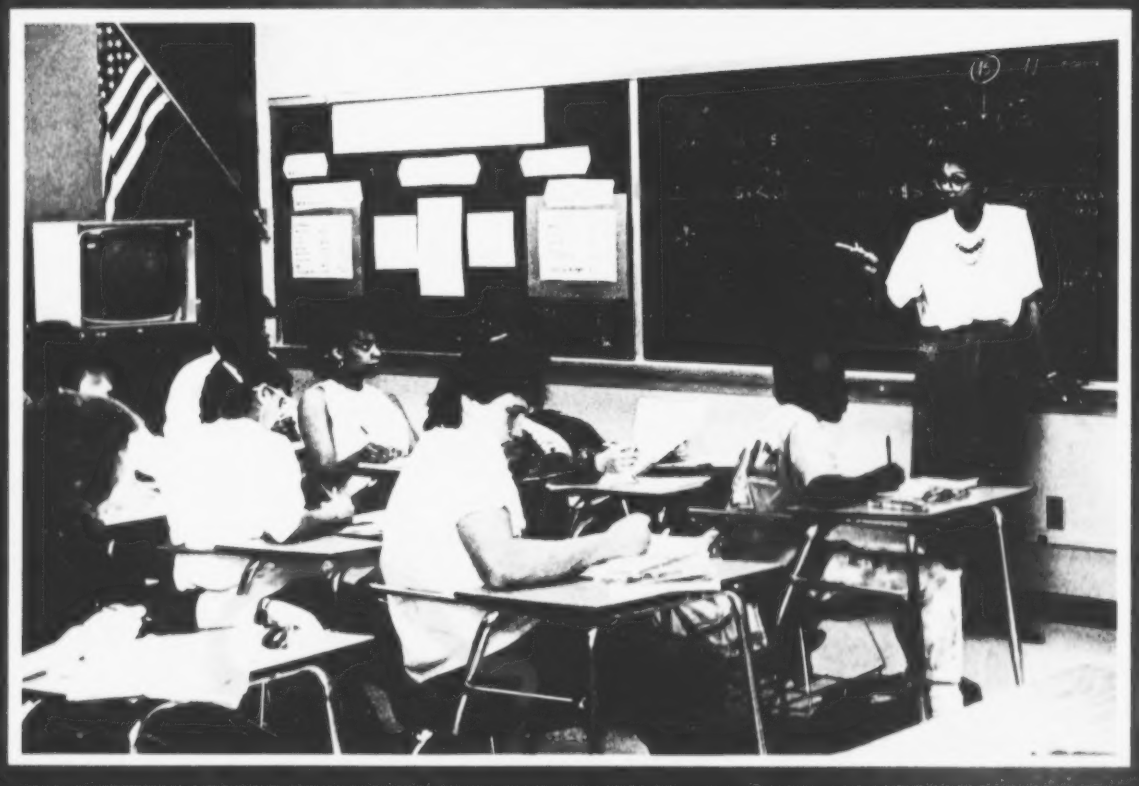
Evaluating Impact

The district computer coordinator will want to monitor progress toward implementing changes in the district program by providing the computers-in-education committee with periodic updates of the program improvement plan. The third work sheet in Appendix D can be used to note changes that have been made and summarize problem areas still in need of attention. Individual efforts to support the change process should be noted and encouraged. This updating procedure provides positive reinforcement and feedback for those who have helped to implement desired changes. Communication about progress should not be limited to individual conferences or committee meetings; credit for contributions can be communicated to the entire staff and community via newsletter, staff memo, or other appropriate forum.

As they modify their school district's computer plan and curriculum, committee members should keep in mind the following principles of managing change.

- It is easier to change things than people. Schedules must be realistic.
- Those making changes must have the courage of their convictions. This does not imply rigidity, because adaptability may be critical, but it does imply a clear sense of purpose.
- A sound base of objective data must be the foundation for initial planning. After it has been taken into account, diversity of thought can be encouraged.
- The strong, early involvement of all those who will be key participants in effecting change must be sought. It is essential to secure their understanding and commitment and to gain their insights.
- Potential roadblocks must be anticipated in order to minimize surprises.
- The human, financial, and physical resources required must be estimated, and planners must determine whether the cost is affordable.
- Effective channels of communication must be established.
- Timing can be critical. Planners should try to determine if there is a "natural" time to end the old and begin the new.
- Change should be scheduled in measurable, comfortable stages. Too much too soon can be counterproductive.

Change should be scheduled in measurable, comfortable stages. Too much too soon can be counterproductive.



Overview

Computer science is a central pillar of the information age. Its rapid absorption into the nation's school system during a period of significant evolution in computing concepts and related phenomena poses many challenges for curriculum planners and those teaching computer science. Some of the facets of this challenge are explored in this section defining computer science and its competing terms, integrating the unique roles of elementary and secondary curriculum, stating the major goals for computer science, briefly describing current commonly used school computing languages, and displaying a scope and sequence chart for elementary and secondary course work.

Definition

Programming is a relatively new way of thinking and a new way of thinking about thinking. . . .

Computer science is the body of knowledge needed to use the special languages that program the computer to function at the user's command. Programming is a relatively new way of thinking and a new way of thinking about thinking, a subject worthy of study in its own right as are mathematics, science, language arts, and social studies. Currently, programming in kindergarten through grade 12 involves use of procedural languages such as Logo, BASIC, and Pascal. Other nonprocedural languages, such as rule-based Prolog or object-oriented Smalltalk, are just over the educational horizon. But, programming at present means inventing and writing procedures in a given computer language. In a broader sense it also includes using specialized procedures and commands in application programs like word processors, databases, and spreadsheets to invent and write larger procedures for those same applications.

Related Terms

The existence of a number of related terms can obscure the goals of computer science. These related terms are not synonymous yet can include computer science in their agenda and sometimes are added to the computer science agenda.

Computer literacy is one such term. Though its actual definition is open to considerable debate, there is general consensus that computer literacy implies minimal computer science, or programming, skills and includes many other more general goals. *Data processing* generally refers to programming and information needs within the business community. *Information science* deals with the storage and retrieval of large quantities of information and is most closely identified with library sciences. *Information processing* or *informatics* is an umbrella term which includes all of the aforementioned and more, but it places greater emphasis on the coming role of information than on data and the languages that manipu-

late data. *Computer science*, then, must relate to and point to these other concepts, but its unique role is as repository of knowledge about computer languages for problem analysis.

K-12 Integration

The study of computer science should begin with some formal instruction in computer languages in the elementary school. One option is to start teaching the language Logo in grade 2 or 3. This instruction can be usefully integrated into the problem-solving curriculum by any content area of any computer-competent teacher. Instruction in use of Logo could continue through the middle school curriculum as well. Another option is to introduce the BASIC language in upper elementary or middle school grades.

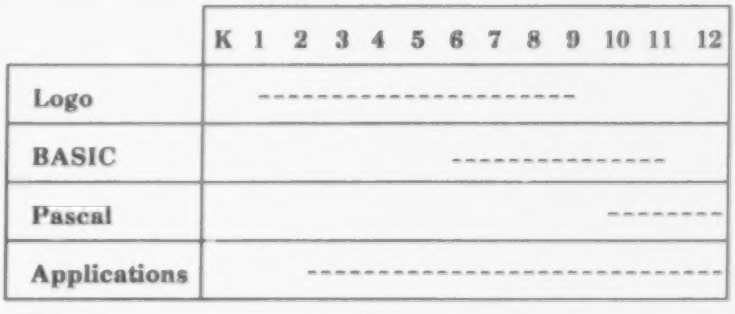
You're put in a learning box to age 18 or 24. Then you're put in a work box . . . . Computers will let you stay in the learning box the rest of your life.
—Osborne Computer's Georgette Psaris
Infoworld

Computer science concepts should not be taught to the exclusion of more general computer literacy goals. If computer literacy goals are met, they will further computer science goals. Application programs should be introduced as software publishers adapt them for given grade levels. Word processing is already possible for first graders. Databases and spreadsheets already come with versions for intermediate grades. Secondary-level students in grades 7 through 12 should continue to solve problems using computer programs of increasing sophistication. These programs should be integrated into all disciplines, including, but not limited to, social studies, science, mathematics, and language arts.

Elective formal computer science courses at the secondary level should be available to interested and capable students. Among these should be courses on the computer languages such as BASIC, Pascal, and the special languages which accompany some computer application programs. Elective courses should cover programming for problem solving with greatest emphasis on problem analysis, algorithm design, and data structures. Consideration should also be given in these classes to teaching aspects of application programs not yet integrated into other secondary course work. Significant guides to secondary computer science curriculum are the *Teacher Guide to Advanced Placement Courses in Computer Science* (1983) and the *Advanced Placement Course Description* (1985) produced by the College Board, Princeton, New Jersey.

Table 8

Computer Language Strands K-12



Goals

That's what education means, to be able to do what you've never done before.
—Alice Freeman Palmer

The study of computer science should include an emphasis on problem-solving strategies, the study of algorithms, and the development and use of established structured programming techniques. The curriculum should stress the first two levels of a problem-solving model developed by Gyorgy Polya—Understand the Problem and Plan the Solution. More information on this model can be found in the second edition of Polya's *How to Solve It* (Princeton, NJ: Princeton University Press, 1971). Adequate problem-solving and algorithm application examples must be given to teach students how to develop appropriate strategies for solving a given set of problems. Algorithmic tools which could be tried out in particular problem settings are graphics, pattern development, number manipulation, search and sort capabilities, and text manipulation.

The three major goals of a computer science curriculum are for students to

- learn and use computer languages for problem solving with emphasis on the computer as a tool,
- master basic programming techniques helpful in using the computer as a tool, and
- learn various applications of problem-solving languages and basic computer techniques to societal goals and issues and career opportunities. Curriculum planners must be aware of an overlap of this goal with other information-age agendas, but programming knowledge can give insight into various other applications of the computer.

The study of a high-level language for its own sake should not be the major goal of this curriculum, but rather any language study should be used to motivate problem solving in a variety of situations and subjects. The foundation of this curriculum is the process of problem analysis.

The foundation of this curriculum is the process of problem analysis.

Logo. Logo is a discovery-oriented, structured computer language useful for helping students think, experiment, and discover. Using Logo's Turtle Graphics, students can experiment with concepts like estimation of distance, angle measure, and variables. Students can develop procedures for creating graphics on the computer screen, and as they experiment and discover new designs, these will become modules within other procedures. These capabilities make Logo an ideal introduction to structured programming for all students. The study and use of Logo extend beyond its Turtle Graphics to its extensive list-processing capabilities and can also include word processing. A curriculum that includes Logo can extend from early elementary school to high school. Educational goals relating to using Logo in the curriculum are

- strengthening creativity and discovery/learning abilities;
- developing problem-solving skills;
- strengthening concepts of spatial relationships;
- developing procedural thinking abilities such as logic, sequence, and order;

- developing intuitive reasoning and estimating skills;
- developing computer programming concepts;
- strengthening mathematical concepts and arithmetic skills;
- strengthening geometry concepts;
- strengthening measuring skills, linear and angular; and
- strengthening language arts concepts.

Table 9

Logo in the Curriculum

I = introduce, D = develop, R = reinforce for mastery

Strands	Readiness		
	K-3	4-6	7-9
Logo			
Turtle Graphics: direction, distance, angle	I	D	D/R
Squares, triangles, circles	I	D	D/R
Procedures: repeated and combined	I	D	D/R
Polygons and curves	I	I/D	D/R
Counting	I	I/D	D/R
Editing	I	I/D	D/R
Coordinates	I	I/D	D/R
Random numbers	I	I/D	D/R
Numbers and arithmetic	I	I/D	D/R
Words and lists	I	I/D	D/R

Basic. BASIC is the language most readily available for student use, as it is built into the majority of computers sold for home and school. As with Logo, an excellent way to introduce BASIC to elementary students is through the writing of programs that generate graphics. Graphics give student programmers instant feedback on the results of their programs.

Students in the middle grades and secondary school are capable of programming in BASIC in a formal programming course. A problem with this language is that it does not require good programming habits and style. Formal instruction in BASIC at the middle school and secondary levels should require the use of top-down programming design to help students learn how to develop a structured program when solving any problem.

The first object of any art of learning, over and beyond the pleasure it may give, is that it should serve us in the future. Learning should not only take us somewhere. It should allow us later to go further more easily.

—Jerome Bruner

Pascal. Pascal is a highly structured, procedure-oriented language that requires the programmer to develop good programming skills. Pascal is designed so that programs can be written in a logical, straightforward fashion. In Pascal, large complex programs are easily subdivided into modules that are easy to program and "debug." This language is widely used for professional programming applications and is the primary language taught in college-level computer science courses.

Pascal is the basis for the advanced-placement computer science curriculum. Any secondary school offering an advanced-placement computer

Pascal is the basis for the advanced-placement computer science curriculum. Any secondary school offering an advanced-placement computer science course must teach a minimum of two semesters of programming in Pascal. The advanced-placement computer science curriculum also requires that the topic of data structures be covered in instruction.

Advanced Topics. A district may also provide instruction in Fortran, Cobol, assembler, and machine language. Topics integrated into advanced courses may be the study of computer systems, system design, design logic, and data structures. Of further interest may be promising new languages, such as rule-based LISP or Prolog and object-based Smalltalk.

Scope and Sequence

The following scope and sequence is the topical outline of a secondary school advanced-placement computer science curriculum. A complete computer science curriculum would have the advanced-placement course as its final goal, and all curriculum activities would lead toward this goal.

Table 10

Scope and Sequence for the Secondary Computer Science Curriculum

I = introduce, D = develop, R = reinforce for mastery

Strands	Readiness		
	Grades 7-8	Grades 9-10	Grades 11-12
Programming Methodology			
Problem definition	I	D	D
Designing modules	I	D	R
Coding terms and style	I	D	D
Debugging and testing	I	D	R
Documentation	I	D	D
Features of a Programming Language			
Data types	I	I/D	D/R
Assignment statements	I	D	R
Control structures	I	I/D	D
Input and output	I	D	R
Procedures	I	I/D	D/R
Data Types and Structures			
Data types	I	I/D	D/R
Data structures	I	I/D	D/R
Tree structures		I	D
Representation of data structures		I	D
Algorithms			
Classes of algorithms		I	D
Searching	I	D	R
Sorting		I	D
Numerical algorithms	I	D	D
Manipulation of data structures		I	D
Applications of Computing			
Test processing	I	I/D	D/R
Simulations and modeling	I	D	D/R
Data analysis	I	I/D	D
Data management	I	I/D	D
Systems software		I	D
Games	I	D	D
Graphics	I	D	D
Computer systems			
Hardware components	I	D	R
Systems software		I	D
Systems configuration	I	I/D	D
Social Implications			
Responsible use of computer systems	I	D	R
Social ramifications of computers	I	D	R

SOCIAL SCIRESEARCH

Overview

In the past several years, a variety of quality resources has become available to help educators plan, implement, evaluate, and modify educational computer programs. The resources listed here were selected to correlate with the recommendations in the various sections of this guide. Some resources were produced in Wisconsin; others are provided through a variety of state, regional, and national publishers and producers.

It is very important in this rapidly changing field to keep current with trends and issues relating to education . . . .

This list was as current as possible when this guide was printed. The Computer Education Task Force encourages Wisconsin educators to update the list regularly. It is very important in this rapidly changing field to keep current with trends and issues relating to education in order to best meet the needs of Wisconsin students today and in the future.

Curriculum Planning

Anderson, M. Elaine, ed. *Online Database Searching in the Curriculum.* Madison, WI: Wisconsin Educational Media Association, 1986.

Apple Computer Inc. *Science: Curriculum Software Guide.* Cupertino, CA: Apple Computer Inc., 1987.

Appell, Louise, ed. *Using Grolier's Productivity Software Across the Curriculum.* Danbury, CT: Grolier Electronic Publishing Inc., 1986.

Billings, Karen J. *An Evaluation Handbook for a Computer Education Program.* Eugene, OR: International Council for Computers in Education, 1985.

Computer Applications Assessment Profile. Chelmsford, MA: Merrimack Education Center, 1986.

The assessment profile provides a means to monitor the implementation of the local school district's technology applications program. The profile can be used to assess the status of the program's implementation at any time. Results can then be used to make decisions about whether to revise or modify certain aspects of the program or change emphasis and priority focus.

Computer Applications Planning Guidebook (CAPS). Chelmsford, MA: Merrimack Education Center, 1986.

The *Computer Applications Planning Guidebook* provides a model and process for developing a comprehensive long-range plan for using technology in the curriculum. The guidebook is organized according to five major steps.

- Preliminary Planning for Technological Change—developing planning committees, preparing policies, inventorying existing computer activities, conducting awareness sessions, and setting priorities
- Integrating Computers into the Curriculum—developing goals, student competency statements, and curriculum objectives
- Staff Development—identifying required and actual faculty competencies and organizing and delivering training and other staff development services
- Hardware and Software Acquisition—evaluating and selecting software and hardware
- Organization and Implementation—developing program management procedures, logistical materials, and equipment support systems

Computer Applications Planning Template. Chelmsford, MA: Merrimack Education Center, 1986.

The template is designed to be used in conjunction with the *Computer Applications Planning Guidebook* and assists local school districts in the writing of a technology implementation program. The template follows the five categories of the CAPS guidebook and serves as a model outline for presenting a plan for the integration of technology in schools.

Education is. . .hanging around until you've caught on.

—Robert Frost

Costa, Betty, and Marie Costa. *A Micro Handbook for Small Libraries and Media Centers*. 2nd ed. Littleton, CO: Libraries Unlimited, Inc., 1986.

Douziech, Richard, et al. *Computer Literacy Activities for Elementary and Middle School Students*. Eugene, OR: International Council for Computers in Education, 1983. Biweekly.

Educational Software Report. Scholastic, P.O. Box 2038, Mahopac, NY 10541. Biweekly, $95/yr.

This is a new publication which will review all Apple-compatible K-through-12 instructional software released during the five to seven weeks prior to each issue date. Reviews are to be done by a district-level computer coordinator and a classroom teacher.

Helm, Virginia. *Software Quality and Copyright: Issues in Computer-Assisted Instruction*. Washington, DC: Association for Educational Communications & Technology, 1984.

Hunter, Beverly. *My Students Use Computers: Computer Literacy in the K-8 Curriculum*. Reston, VA: Reston Publishing Company, Inc., 1984.

Kepner, Henry S., ed. *Computers in the Classroom*. 2nd ed. Washington, DC: National Education Association, 1986.

Lewis, Sasha. *Plugging In: The Microcomputerist's Guide to Telecommunications*. Chilton's Computing Series. Radnor, PA: Chilton Book Company, 1984.

Mella, L. Sue. *Solutions to Computer Problems in School*. Evergreen, CO: Expanding Development Inc., 1985.

Minneapolis Public Schools. *K-6 Computer Literacy Curriculum*. Minneapolis, MN: Minneapolis Public Schools, 1985.

Minnesota Educational Computing Corporation. *MECC Computer Lab Guidebook: Planning, Reference and Presentation Materials*. St. Paul, MN: Minnesota Educational Computing Corporation, 1985.

Minnesota Educational Computing Corporation. *MECC Computers in the Curriculum: A Computer Literacy Guide*. St. Paul, MN: Minnesota Educational Computing Corporation, 1984.

Minnesota Educational Computing Corporation. *MECC Computing and Information Teacher's Guide: Instructional Computing Courseware for the Apple II Computer*. St. Paul, MN: Minnesota Educational Computing Corporation, 1985.

Minnesota Educational Computing Corporation. *MECC Student Activity Cards*. St. Paul, MN: Minnesota Educational Computing Corporation, 1985.

Moursund, Dave. *The Computer Coordinator*. Eugene, OR: International Council for Computers in Education, 1985.

Moursund, Dave, and Dick Ricketts. *Long-Range Planning for Computers in Schools*. Eugene, OR: Information Age Education, 1987.

Moursund, Dave, and Dick Ricketts. *Long-Range Planning for Computers in Schools*. Computer software. Information Age Education, 1987. Macintosh, disk.

Moursund, Dave, and Dick Ricketts. *Planning for Information-Age Schools*. 6/yr. Information-Age Education, 1250 East 29th Place, Eugene, OR 97403-1621.

Oman, Paul W. "A Paradigm for K-8 Curricular Design." *T.H.E. Journal* 14.2 (Sept. 1986), pp. 82-88.

Little attention has been afforded to establishing guidelines for a K-through-8 computer curriculum in national publications, although early computer education is one of today's most important educational technology issues. This comprehensive model was prompted by requests from schools wrestling with the problems of incorporating computer education and serves as a guide upon which schools can build.

This comprehensive model was prompted by requests from schools wrestling with the problems of incorporating computer education . . . .

Pogrow, Stanley. *Education in the Computer Age: Issues of Policy, Practice, and Reform*. In *Managing Information: A Series of Books in Organization Studies and Decision-Making*. Vol. 6. Beverly Hills, CA: Sage Publications, 1983.

Sanders, Jo Shuchat, and Antonia Stone. *The Neuter Computer: Computers for Girls and Boys*. New York: Neal-Schuman Publishers, Inc., 1986.

Shostak, Robert, ed. *Computers in Composition Instruction*. Eugene, OR: International Council for Computers in Education, 1984.

Technology in the Curriculum Handbook. Chelmsford, MA: Merrimack Education Center, 1986.

Technology in the Curriculum Handbook serves as a resource for teachers and administrators developing appropriate applications of computers and related learning technologies in various content areas. The publication provides a comprehensive program design for incorporating technology in the curriculum and a set of procedures for undertaking the groundwork, as well as illustrations of these procedures. The publication supplements the *Computer Applications Planning Guidebook* with an in-depth description of curriculum applications and specific listings and suggestions for implementation.

Technology Lighthouse of the Merrimack Education Center. *Computer Applications Planning: A Guide to Planning and Implementing a District-wide Computer Program*. Chelmsford, MA: Merrimack Education Center, 1984.

Torgerson, Shirley. *Logo in the Classroom*. Eugene, OR: International Council for Computers in Education, 1984.

Troutner, Joanne. *The Media Specialist, the Microcomputer, and the Curriculum*. Littleton, CO: Libraries Unlimited, Inc., 1983.

Rooze, Gene E., and Terry Northup. *Using Computers to Teach Social Studies*. Littleton, CO: Libraries Unlimited, Inc., 1986.

Wisconsin Department of Public Instruction. *A Guide to Curriculum Planning in Art Education*. Madison, WI: Department of Public Instruction, 1986.

A Guide to Curriculum Planning in Art Education addresses four instructional areas: art heritage, art criticism, aesthetics, and art making. Its comprehensive approach to art education stresses the knowledge, skills, and concepts that should be incorporated into every student's education. The guide's content is designed to educate responsible decision makers about basic issues concerning the quality of visual environments. The guide is divided into four sections: "Introduction" (overview, philosophy, goals, current and future issues, and equity); "Curricular Framework"; "Content of Art"; and "Local Curriculum Development." The "Content of Art" section covers the following:

- a comprehensive curriculum,
- aesthetics,
- art heritage,
- art criticism,
- basic art making,
- art career education, and
- K-through-12 art unit examples.

In addition, appendixes include resources, state and national art organizations, Wisconsin's school district standards, and a current list of other reference materials.

Wisconsin Department of Public Instruction. *A Guide to Curriculum Planning in English Language Arts*. Madison, WI: Department of Public Instruction, 1986.

A Guide to Curriculum Planning in English Language Arts provides a framework for designing or revising curriculum for kindergarten through twelfth-grade students. Student development in English language arts is described through scope-and-sequence charts for the primary, intermediate, middle/junior high school, and senior high school levels. Emphasis throughout the guide is on language as a means of communication and as a learning tool. Contents of the guide include discussions of philosophy, objectives, goals, instructional approaches, evaluation, sample lessons, equity, and advice to parents. Sections address the following areas:

- language,
- literature, and
- communication skills—listening, speaking, reading, writing, and using media.

Additional chapters discuss the curriculum development process as well as a series of critical issues, including competency testing, heterogeneous grouping, classroom climate, and censorship. Appendixes include "Resources," "Proposed Guidelines for Free and Responsible Student

Journalism," "Workload and the Teaching of Secondary School English," and "Guidelines for Nonsexist Use of Language."

Wisconsin Department of Public Instruction. *A Guide to Curriculum Planning in Environmental Education*. Madison, WI: Department of Public Instruction, 1986.

Based on the recommendations of both international and national studies, *A Guide to Curriculum Planning in Environmental Education* promotes the infusion of environmental content into all subject areas at all grade levels. It identifies five categories of objectives: awareness, knowledge, attitudes, skills, and participation. It further recommends that major emphasis be given to specific topics in each of four grade groupings from kindergarten through grade 12. The guide is designed to help teachers assist students in understanding how the environment functions, how people interact with it, and how environmental issues and problems arise and can be solved. It provides information about the following areas:

- fundamental environmental principles,
- environmental value development,
- approaches to teaching and learning,
- infusion of environmental topics into the existing curriculum,
- developing an environmental education program, and
- current environmental education issues.

Appendixes include resources, starter programs, sample infused units, topics for infusion, and other legal and statutory writings.

Education is the acquisition of the art of the utilization of knowledge.
—Alfred North Whitehead

Wisconsin Department of Public Instruction. *A Guide to Curriculum Planning in Foreign Language*. Madison, WI: Department of Public Instruction, 1986.

A Guide to Curriculum Planning in Foreign Language recommends four levels of study in response to the questions, "What should students be able to say, understand, read, and write at the end of 600 hours of allocated instruction in a foreign language?" It recognizes that students who learn a second language benefit in practical ways: they are better able to communicate with native speakers in this country and other nations, they have a better understanding of other cultures, and they are better prepared for potential careers. The guide is designed to assist schools in creating a comprehensive foreign language program at either the elementary or secondary school level. In doing so, it addresses the following areas:

- program descriptions, including K-through-12 coordination;
- recent trends;
- proficiency guidelines;
- generic functions for all modern languages;
- scope and sequence—French, German, and Spanish; and
- foreign language media, including computers.

A final chapter addresses improving instruction and evaluating textbooks and student performance. An extensive glossary is also included.

Wisconsin Department of Public Instruction. *A Guide to Curriculum Planning in Health Education*. Madison, WI: Department of Public Instruction, 1986.

A Guide to Curriculum Planning in Health Education provides direction and assistance to schools wishing to develop a comprehensive K-through-12 health instruction program. A local health education curriculum committee or coordinating team can use the guide to develop, implement, and evaluate school health instruction. The guide introduces a philosophy, goals, objectives, sample lessons, and other materials to help teachers responsible for health education plan specific instructional programs. A major part of the guide is devoted to recommended student objectives and time allocations for those objectives. Sections cover the following major content areas:

- accident prevention and safety,
- community health,
- consumer health,
- environmental health,
- family life education,
- mental and emotional health,
- nutrition,
- personal health,
- disease prevention and control, and
- substance use and abuse.

The guide also provides an overview of current and future issues as well as careers in health education. Appendixes offer resources, a checklist for evaluating a school health education program, and criteria for comprehensive school health education.

Wisconsin Department of Public Instruction. *A Guide to Curriculum Planning in Mathematics*. Madison, WI: Department of Public Instruction, 1986.

Some students must be prepared for advanced training in mathematics and mathematics-related fields. All students must be prepared to use mathematics as informed, thoughtful citizens. *A Guide to Curriculum Planning in Mathematics* contains recommendations to assist mathematics teachers in developing programs that will meet both of these objectives. The guide suggests instructional objectives for grades 1 through 3, 4 through 6, 7 through 8, and 9 through 12 in the following strands: number and numeration, measurement, geometry, statistics, algebra, discrete mathematics, and problem solving. Recommendations call for greater emphasis on

- numeration concepts;
- estimation, mental arithmetic, and the use of calculators;

- measurement, geometry, and statistics at all grade levels; and
- problem solving at all grade levels.

Less emphasis is placed on abstract symbol manipulation, especially pencil-and-paper computation with large numbers. A section on the secondary school mathematics program suggests ways to meet the needs of students who will not continue to study mathematics after graduation as well as those students who will enroll in some form of postsecondary education. Issues in mathematics education—equity, instructional issues, time-on-task, individual differences, calculators, computers, and others—are addressed in a series of brief essays. The appendixes contain the recommendations of nine major national reports developed over the last decade.

Wisconsin Department of Public Instruction. *A Guide to Curriculum Planning in Music*. Madison, WI: Department of Public Instruction, 1986.

A Guide to Curriculum Planning in Music uses a conceptual approach to teaching music, based on the elements of expression, melody, rhythm, harmony, timbre, texture, and form. Broad concepts are listed for each element, the mastery of which occurs by performing, describing, and creating music in each of six graduated cycles, or ability levels. Through a multidimensional experience in music, students can gain a deeper understanding of music as well as the ability to perform, produce, and use music independently. The guide's introduction offers a background, rationale, and goals for curriculum development in addition to definitions for each of the musical elements. Other sections of the guide address the following areas:

Through our great good fortune, in our youth our hearts were touched with fire.

—Oliver Wendell Holmes, Jr.

- music outcomes—general, choral, and instrumental;
- management of the school music program;
- issues in music education including community-related issues, careers, computer applications, professional growth, music for the exceptional child, and learning styles.

Four appendixes offer standards for approved music teacher preparation programs, a program standards self-evaluation checklist, sample activity work sheets, and a chart of recommended minimum allocated instructional times.

Wisconsin Department of Public Instruction. *A Guide to Curriculum Planning in Physical Education*. Madison, WI: Department of Public Instruction, 1986.

A Guide to Curriculum Planning in Physical Education can assist educators who are just beginning curriculum development, provide guidelines for such ongoing work, or serve as an evaluation tool for programs already in place. It is organized around four goals dealing with physical fitness, psychomotor skills, knowledge, and attitudes. It suggests 21 program objectives along with sample student objectives at each of five develop-

mental levels. The guide offers practical recommendations in sections on each of the following:

- evaluation;
- administration;
- management;
- instruction; and
- integration of physical education into mathematics, language arts, science, health education, environmental education, and career education.

A series of appendixes provides examples of programs, management and administrative items, resources, and bibliographic materials.

Wisconsin Department of Public Instruction. *A Guide to Curriculum Planning in Reading*. Madison, WI: Department of Public Instruction, 1986.

A Guide to Curriculum Planning in Reading emphasizes the importance of developing strategic readers who search for meaning as they monitor their own comprehension. The guide is designed to facilitate effective and creative decision making by teachers for integrating reading and writing across the curriculum, developing readers who can independently apply appropriate strategies to a variety of texts and tasks for constructing meaning, and developing mature readers who will choose reading as an independent activity during and beyond their school years. Opening sections define reading comprehension as an interactive process, offer methods for developing strategic readers, and recommend reading skills and strategies in a K-through-12 scope and sequence. An implementation section focuses on instruction and covers the following areas:

- analyzing the curriculum,
- planning for instruction,
- organizing for instruction,
- selecting instructional materials,
- evaluating the reading curriculum, and
- contributors to an effective reading program.

The appendixes include an extensive series of bibliographies as well as samples of activities designed to help integrate reading into the curriculum.

Wisconsin Department of Public Instruction. *A Guide to Curriculum Planning in Science*. Madison, WI: Department of Public Instruction, 1986.

A Guide to Curriculum Planning in Science offers a balanced treatment of four science education components: problem solving; science knowledge; the nature of science; and science, technology, and society. It contains 22 detailed objectives and examples of appropriate subobjectives and teaching activities. The guide also offers a rationale for the proposed structure and a discussion of the learning theory that provides the basis for given objectives at specific grade levels. In addition, evaluation recom-

mendations are made throughout the document, which offers five curriculum development options. The guide provides a detailed strategy for using the ideas so that they fit together into an articulated K-through-12 science curriculum. Sections contain discussion relating to the following:

- objectives for K-through-12 science curriculum;
- a process for developing a science curriculum;
- evaluating students and programs;
- current and future issues; and
- science curriculum for kindergarten through grade 2, grades 3 through 6, middle/junior high school, and senior high school.

The section on current and future issues addresses time allocation, integrating science into the total curriculum, computers, science careers, and equity in science education.

Wisconsin Department of Public Instruction. *A Guide to Curriculum Planning in Social Studies*. Madison, WI: Department of Public Instruction, 1986.

A Guide to Curriculum Planning in Social Studies offers educators a detailed discussion of the essential elements contained in a good K-through-12 social studies program. The guide stresses a process for curriculum development and improvement, with specific recommendations on scope and sequence, evaluation of both students and programs, implementation procedures, and resources for teachers—including computer software. Among major issues it addresses are school reform, the importance of subject matter in an information age, and today's curriculum as an outgrowth of yesterday's tradition and change. For each course and grade level, the guide offers a list of concepts/key ideas relating to identified major themes. Among major themes presented are

- cause and effect,
- celebration of pluralism,
- change and continuity,
- citizenship,
- community,
- culture,
- equal opportunity,
- freedom and justice,
- government and authority,
- human rights,
- independence and interdependence,
- peace,
- scarcity and choice,
- stewardship of natural and human resources, and
- survival issues and future alternatives.

A lengthy resource section is followed by a series of appendixes which include discussions of, among other topics, allocated instructional time, writing in the social studies, and instructional television programs.

If a nation expects to be ignorant and free, in a state of civilization, it expects what never was and never will be.
—Thomas Jefferson

Wisconsin Instructional Computing Consortium. *Computer Curriculum Materials for Elementary and Secondary Education*. Chippewa Falls, WI: Wisconsin Instructional Computing Consortium, 1986.

The following materials may be purchased by Wisconsin Instructional Computing Consortium (WICC) associate members at a discount. The listed price includes reproduction rights for printed materials used within a school district.

- *Computer Concepts* (K through 3). This is designed to introduce elementary students to the Apple computer, including hardware and basic operation of computer software. Students learn appropriate vocabulary terms and gain an understanding of how the computer operates. It requires the *MECC Friendly Computer* software program. Suggested additional resources are listed in the *Computer Concepts* manual.

WICC members	$ 95
Nonmembers	$ 180

- *Keyboarding* (4 through 8). Students are taught keyboarding skills to insure more efficient operation of the computer and software programs. The correct manipulation of a computer keyboard is a prerequisite to word processing and other computer operations. This curriculum is available in two versions, The *MECC Keyboarding* series and the *CompuKeys* program. It requires the appropriate keyboarding program.

The correct manipulation of a computer keyboard is a prerequisite to word processing and other computer operations.

WICC members	$ 95
Nonmembers	$180

- *Language Arts Activities to Teach Word Processing* (4 through 8). Word processing allows students to access, display, organize, alter, and evaluate information. This curriculum is designed to teach and reinforce language arts skills through active involvement and application of word processing skills. The goal is for students to use the word processor as a writing tool. The *MECC Writer* program is required.

WICC members	$ 95
Nonmembers	$180

- *Introduction to the Computer* (7 through 12). The student- and teacher-designed manual introduces students to the basic operation of an Apple IIe computer. It requires the *Apple Presents Apple* disk and *Solutions Unlimited* manual and disk.

WICC members	$25
Nonmembers	$50

• *AppleWorks* (7 through 12). Requires the *AppleWorks* program and *Solutions Unlimited* manual and disk. This package includes the following four titles.

—*Introduction to AppleWorks*. Introduces the *AppleWorks* program, including terms and hands-on activities designed to familiarize students with the various uses and advantages of integrated software. Student and teacher manuals are included.

—*Introduction to AppleWorks – Word Processing*. A student and teacher manual including overhead masters, student activities, and a structured format for presenting material to teach the *AppleWorks* word processing program.

—*Introduction to AppleWorks – Data Base*. Introduces data processing terms and activities designed to allow a student to edit, create, and report using databases. Student and teacher manuals are included.

—*Introduction to AppleWorks – Spreadsheet*. Designed to teach students the basic concept of electronic spreadsheets. Several activities allow the student to become familiar with spreadsheet applications. Student and teacher manuals are included. Price includes all four titles.

WICC members	$ 95
Nonmembers	$180

Woolls, E. Blanche, and David V. Loertscher, eds. *The Microcomputer Facility and the School Library Media Specialist*. Chicago, IL: American Library Association, 1986.

Wresch, William, ed. *The Computer in Composition Instruction: A Writer's Tool*. Urbana, IL: National Council of Teachers of English, 1984.

Inservice Resources

Minnesota Educational Computing Corporation. *Integrating Computing into the Curriculum: Training Materials*. St. Paul, MN: Minnesota Educational Computing Corporation, 1985.

Minnesota Educational Computing Corporation. *MECC Databases: Teacher In-Service Training*. St. Paul, MN: Minnesota Educational Computing Corporation, 1986.

Minnesota Educational Computing Corporation. *Using the MECC Computing and Information Collection: Training Materials for the Apple II Computer*. St. Paul, MN: Minnesota Educational Computing Corporation, 1986.

Wisconsin Department of Public Instruction Microcomputer Center/Library, third floor, GEF 3, 125 South Webster Street, P.O. Box 7841, Madison, WI 53707; (608) 266-2529.

The Microcomputer Center/Library (MCL) is designed to serve the needs of Department of Public Instruction staff and to assist Wisconsin K-through-12 educators. It is open from 7:30 a.m. to 4:30 p.m., Monday through Friday, 12 months a year.

The MCL has a growing collection of software, both donated and purchased, and microcomputers representative of those most commonly found in Wisconsin schools. The MCL software collection does not circulate; rather it serves as an examination collection for all Wisconsin educators. Wisconsin educators are invited into the MCL to use and to compare software for themselves.

To assist in the examination of software, the MCL offers major software review sources and access to online databases as well as staff to aid in use of both the software and the review sources.

The Microcomputer Center/Library provides the following services for Wisconsin educators.

- Assistance with review sources for educational software. These include both online databases and print sources.
- Use of the growing software collection in the MCL. This is an examination collection and does not circulate, so that the software will always be available to Wisconsin educators.
- Use of the microcomputers in the MCL to evaluate software and to become familiar with the different types of hardware and various peripherals.
- Assistance in locating software to meet a specific need. MCL staff will search the review sources and provide suggestions of software products for Wisconsin educators to consider.
- Assistance with integrating software into the curriculum.
- Group visits available by appointment.

Wisconsin Instructional Computing Consortium, 725 West Park Avenue, Chippewa Falls, WI 54729; (715) 723-0341.

The Wisconsin Instructional Computing Consortium . . . is a nonprofit organization that has evolved through the cooperative efforts of Wisconsin's educational agencies.

The Wisconsin Instructional Computing Consortium (WICC) is a nonprofit organization that has evolved through the cooperative efforts of Wisconsin's educational agencies. Its purpose is to provide instructional computing services to the state's elementary and secondary schools.

WICC member agencies assist educators and others to plan and implement comprehensive instructional computing programs. The five major goals of WICC are

- to promote and encourage the use of computer technology in instruction;
- to facilitate sharing and exchange of ideas, techniques, materials, and procedures for use in instructional computing programs;

- to provide consultation and assistance to school districts in the design and planning of computing applications in education;
- to assist in compiling computer courseware libraries for selected microcomputers; courseware is to be developed by member institutions or obtained through contractual agreements with developers such as the Minnesota Educational Computing Corporation (MECC); and
- to seek and implement statewide purchasing arrangements for select hardware and software products which meet the needs of educational institutions in Wisconsin.

Services provided to member school districts by distributing member institutions vary, but services typically include

- Minnesota Educational Computing Corporation (MECC) membership,
- discount on MECC materials,
- on-site consultant support,
- phone-in consultant support,
- staff development through conferences and workshops,
- inservice training,
- coordination of hardware purchase and maintenance,
- access to software agreements and discounts,
- statewide WICC newsletter,
- access to WICC and MECC courseware libraries, and
- preview centers.

For additional information about regional services, educators should contact the agency that serves their area of Wisconsin.

- CESA 1: West Allis, (414) 546-3000
- CESA 2: Milton, (608) 755-2311
- CESA 3: Fennimore, Southern Wisconsin Instructional Computing Consortium, (608) 822-3276
- CESA 5: Portage, Instructional Microcomputer Support Service, (608) 742-8811
- CESA 7: Green Bay, Regional Computer Center, (414) 497-3755
- CESA 10: Chippewa Falls, Northwest Computer Support Center, (715) 723-0341
- Wisconsin Department of Public Instruction Liaison to WICC, DPI Microcomputer Center/Library, (608) 266-2529

Next Steps with Computers in the Classroom. WHA-TV, University of Wisconsin, Madison, WI, 1985.

This series of videotapes and instructor's guides is designed for teachers and educators who have had some experience with computers. Information is presented to help create an environment in which trends and issues regarding computer and other technologies can be used as effective tools in the educational process now and in the future. The series lends itself to discussion of change in educational delivery systems, teaching styles, curriculum, and basic skills.

Program 1. *The Information Age.* This provides an overview of the more mundane and pervasive uses of computers, a look at some innovative uses, and a view of the implications of the Information Age.

I hear and I forget; I see and I remember; I do and I understand.
—Chinese Proverb

Program 2. *Software Evaluation.* The program reviews instructional computing and the ways in which computers have been used to increase an individual's control over his/her environment.

Program 3. *Software Selection.* A variety of tools for software selection and evaluation are discussed. Jack Traube of the National Information Utility outlines future prospects for distributing software by telecommunication.

Program 4. *The Writing Process.* Experts reflect on the value of computers in the writing process.

Program 5. *The Creative Arts.* Children explore graphic design, musical composition, and kinetic art using computers. A discussion of visions for the future follows.

Program 6. *Electronic Tools.* This presents developments in the major components of computer systems and implications for education.

Program 7. *Telecommunications.* Local area networks are examined before attention is turned to the use of distant databases and discussion of the role of computer communications for schools.

Program 8. *Instructional Management.* This program provides a look at instructional management by behavioral objective. Some tentative steps toward the management of self-direction are followed by observations on student ownership of education.

Program 9. *Creating Courseware.* Footage of teachers involved in creating or modifying courseware is followed by a look at *Solutions Unlimited*—a major piece of courseware—and a discussion with a McGraw Hill executive on methods of courseware development.

Program 10. *Interfacing.* Students use a variety of mechanical, electronic, musical, and artistic devices interfaced with computers. The application of interfacing to the needs of handicapped students emphasizes the use of the computer as a prosthetic device.

Program 11. *Programming Perspectives.* A discussion of microworlds and programming activities culminates with an explanation of why programming is essential for every child.

Program 12. *Alternative Futures*. This program looks at the application of communications technology to the education of children, followed by speculations on the future of schools and society.

Software Evaluation Resources

The Computer Database. 1983-present, 30,000+ citations, updated every two weeks. Available on DIALOG.

The Computer Database abstracts and indexes more than 500 computer-related journals, including many education-related titles. It provides wide-ranging information on computers, telecommunications, and electronics. The database is designed to answer questions of professionals in any field about hardware, software, peripherals, and services.

Education Resources Information Center (ERIC). 1986-present, updated monthly. Available on BRS and DIALOG.

ERIC indexes more than 700 education-related journals. Software reviews published in these journals can be easily identified. The documents portion of ERIC includes the full text of *MicroSift* evaluations.

High Quality Courseware List. State of Minnesota, Department of Education.

Each software item included in this online directory has been reviewed by five educators—three teachers, one content specialist, and one technology specialist. Inclusion in the database indicates the software is judged to be worthy of consideration for purchase. Criteria were developed by the Minnesota Department of Education and fall into three categories: instruction, content, and technology/documentation. This is an ongoing project and is regularly updated.

International Software Database. 1973-present, 15,000 citations, updated monthly. Available on DIALOG.

The *International Software Database* is a comprehensive collection of information about computer software programs. It includes programs for mainframes as well as for microcomputers.

Microcomputer Index. 1981-present, 10,000+ citations, updated monthly. Available on DIALOG.

Microcomputer Index contains citations of literature on uses of microcomputers in business, education, and the home. It provides subject access to 30 microcomputer journals. Included are general articles about the microcomputer world, book reviews, software reviews, discussions of applications, descriptions of new products, and more.

Micro-Courseware PRO/FILE and Evaluation. Educational Products Information Exchange Institute, P.O. Box 839, Watermill, NY 11976.

Educational Products Information Exchange Institute has teamed up with Consumer's Union to produce an ongoing series of in-depth courseware evaluations. To date, the series includes approximately 720 evaluations. The selection includes all curriculum areas and grade levels. Software for Apple, Atari, Commodore, IBM PC, Radio Shack, and Texas Instruments microcomputers is included. The reports provide an analyst's summary of findings plus ratings for instructional quality, technical quality, cost effectiveness, and ease of implementation. These evaluations are printed on 8½" by 11" cards and can be filed in a plastic carrying case.

Knowledge is of two kinds: we know a subject ourselves, or we know where we can find information upon it.
—James Boswell

MicroSift. Northwest Regional Educational Laboratory, 300 Southwest Sixth Avenue, Portland, OR 97204.

MicroSift evaluations of educational software were produced by the Northwest Regional Educational Laboratory, a center which has been involved in developing methods and materials for the educational use of computers for more than ten years. This collection includes approximately 500 reviews of software for most subject areas. The Northwest Regional Educational Laboratory is also producing a set of evaluations of science lab tool software, keyboarding software, and other applications software. Software for Apple, Atari, Commodore, IBM, and Radio Shack computers is included. These evaluations are produced by a network of trained educators throughout the country. They address questions of content and structure, documentation, objectives, potential uses, and major strengths and weaknesses. An evaluation summary table is included with each program. The evaluations are reproducible without copyright limitations. They are also available through the RICE and ERIC online databases.

National Education Association. *The Yellow Book of Computer Products for Education.* Washington, DC: National Education Association, Education Computer Service, 1984-present.

The National Education Association (NEA) has produced this catalog of software which has been judged to be worthy of consideration for purchase. The areas judged are technical reliability, instructional integrity, and ease of use. The catalog includes software in most subject areas and for most grade levels. It is updated periodically. In 1986, NEA changed this to an annual list of most highly rated programs.

Only the Best: The Discriminating Software Guide for Preschool-Grade 12. Education News Service, Sacramento, CA. 1985-present, annual, $21.95/yr.

The editors of *School/TechNews* compile this listing of educational software. Sixteen evaluation services are examined to identify approximately 100 of the most highly rated programs. Descriptions of the programs along with excerpts from reviews are included. A list of software for special education is also provided.

Resources in Computer Education (RICE). 1980-present, updated monthly. Available on BRS.

RICE provides information on educational computer applications. Information about producers of educational software and software descriptions are included. Some of the software descriptions feature a *MicroSift* evaluation.

Software Digest Ratings Newsletter. Software Digest, Inc., One Winding Drive, Philadelphia, PA 19131. Monthly, $245/yr.

This digest discusses and rates business software for the IBM PC and compatible computers. Each issue focuses on one application, such as word processing, file management, or communications. A general article presents the application and is followed by a detailed description and ratings of each program. This is not education oriented, but it is useful for selecting IBM software for applications like word processing and spreadsheets.

Software Reports: The Guide to Evaluated Educational Software. Trade Service Publications, Inc., 10996 Torreyana Road, San Diego, CA 92121. Biweekly, $149.50/yr.

This loose-leaf service provides reviews of educational software in 20 subject areas and for all grade levels. Each review includes a summary of the program features, a description of the program, and a graded evaluation plus comments.

Software Reviews on File. Facts on File, Inc., 460 Park Avenue South, New York, NY 10016. $145/yr.

This digest (formerly *The Digest of Software Reviews: Education*) combines the publisher's description with excerpts from published reviews of software. For those who have no access to journal indexes, this is a tool for finding reviews.

TESS: The Educational Software Selector. Educational Products Information Exchange Institute, P.O. Box 839, Water Mill, NY 11976. 1984-present; annual, $59.95/yr.

TESS is a catalog of approximately 5,000 educational software titles covering all subject areas and grade levels. Software for all major microcomputers is included. Although primarily a catalog, about 2,000 references to published reviews are listed.

Computer-Related Journals

Classroom Computer Learning. Peter Li, Inc., 2451 East River Road, Dayton, OH 45439. 8/yr.

The Computing Teacher. International Council for Computers in Education, University of Oregon, 1787 Agate Street, Eugene, OR 97403-1923. 9/yr.

Electronic Education. Electronic Communications, Inc., Suite 20, 1311 Executive Center Drive, Tallahassee, FL 32301. 8/yr.

Electronic Learning. Scholastic Inc., 730 Broadway, New York, NY 10003-9538. 8/yr.

Teaching and Computers. Scholastic Inc., 730 Broadway, New York, NY 10003-9538. 8/yr.

T.H.E. Journal: Technological Horizons in Education. Information Synergy, Inc., 2626 South Pullman, Santa Ana, CA 92705. 10/yr.

Computer Software and Instructional Television Packages

Genetics. Computer software and videotapes. Wisconsin Educational Communications Board, 1985. Apple II+/e (64K).

Accompanied by three 15-minute video programs, the tutorial disk and laboratory simulation disks at two levels of difficulty allow students to simulate genetics experiments.

Studies of high school genetics instruction show that students learn most concepts presented in class, but they have difficulty applying and integrating this knowledge. The imaginary planet Gensim with its diverse population of Geomets can help students relate genetics concepts to one another, to other biological concepts, and to their own lives. Easy and complex simulation levels help students explore variables such as the interaction between body characteristics and environment. This package was developed by the Wisconsin Public Television Network. Grades 9 through 12. $25.

Income/Outcome$. Computer software. Agency for Instructional Technology, Canadian Foundation for Economic Education, Joint Council on Economic Education, 1986. Apple IIe (64K) or IBM PC.

Eight interactive computer units present key economics concepts. The first unit uses a computer-aided design (CAD) to help students construct ERSTAR, an imaginary space station in low orbit above Earth. Actually, it is a model of the circular flow of macroeconomic activity. Subsequent computer units explore such economic concepts as sources of economic growth, financial intermediaries, market analysis, the government role in economic growth, macroeconomic policy, and international trade.

Income/Outcome$ teaches economics through realistic simulation; student control of the pacing of lessons makes this package usable with a wide range of learners. The series, developed by the Agency for Instructional Technology, can be integrated into all social studies classes where economic principles are taught, as well as into traditional economics classes. Grades 9 through 12. $75.

Interactions in Science and Society. Computer software and videotapes. Wisconsin Public Television Network, 1986. Apple II+/e (64K).

Three disks and three 20-minute video programs explore issues of acid rain, genetic engineering, and the automobile.

Using the Wisconsin Department of Public Instruction's latest curriculum guidelines for science, this package, funded in part by the National Science Foundation and developed by the Wisconsin Public Television Network, helps science teachers explore their field using concepts of science, technology, and society.

Documentary videos present central topics of acid rain, genetic engineering in agriculture, and the automobile through five identified realms of science, technology, and society interaction—economics, politics, society's needs, personal needs, and attitudes and beliefs. Students must then make decisions related to these realms in the computer simulations. Three additional teacher videos examine "Attitudes and Beliefs," "Economics," and "Teaching *Interactions in Science and Society: Acid Rain and Genetic Engineering*." Grades 9 through 12. $25.

If a little knowledge is dangerous, where is the man who knows so much as to be out of danger?
—Thomas H. Huxley

Solutions Unlimited. Computer software. Agency for Instructional Technology, 1985. Apple II+/e (48K).

Eight computer disks are accompanied by eight video programs of varying length which help students practice problem solving.

Each video program demonstrates a skill or poses a problem for students to solve. In small groups or individually, students use the computer software to sharpen their skills as they identify problems, think of and try solutions, and evaluate results. Grades 5 through 8. $40.

Storylords. Computer software and videotapes. Wisconsin Educational Communications Board, 1985. Apple II + /e (64K).

Twelve computer disks are accompanied by twelve 15-minute instructional television (ITV) video programs which use reading comprehension strategies.

The young hero Norbert and the good Storylord Lexor will coach beginning readers to master reading comprehension skills in their duel with the wicked Storylord Thorzuul.

Each disk reinforces skills learned in the complementary video program and allows students to apply the concepts to new situations. The materials, developed by the Wisconsin Public Television Network and funded in part by the U.S. Department of Education, reflect material in the Wisconsin Department of Public Instruction's *Guide to Curriculum Planning in Reading*. Grades 2 through 4. $50.

Audiovisual Materials

The following is a list of audiovisual materials about computers. These materials can be borrowed at no charge from the Wisconsin Reference and Loan Library through established interlibrary loan channels. Those wishing to borrow materials from the Reference and Loan Library should contact their local public library or public library system headquarters.

All About Computer Graphics. Filmstrip, cassettes, and guide. Educational Dimensions, 1983. 80 minutes.

This filmstrip discusses computer graphics, how they work, and how they are changing people's lives. It reveals the full range of applications in business, industry, education, and entertainment, and defines terms used in the field. Contents include "Graphic Horizons," "How It Works," "Two Dimensional Graphics," and "Three Dimensional Graphics."

The Captain Is a Lady. VHS videotape. CBS News/Carousel Films, 1983. 50 minutes.

This provides a cameo portrait of U.S. Navy Captain Grace Murray Hopper, who was a pioneer in the development of computers during World War II and is the oldest uniformed officer on active service in the U.S. Armed Forces. The videotape also offers a look at some computer history and the impact of computers. It was originally broadcast on the CBS television program "60 Minutes."

Computers. Computer Literacy Series. Filmstrip, cassette, and guides. Marshfilm Enterprises, 1983.

A talking Apple II microcomputer explains the basics of computers to a group of students. It provides a historical overview, tours an Apple manufacturing plant, and describes the operation and applications of a microcomputer. Contents include "Computers: How They Got Here," "Computers: How They Are Made and Used," "Computers: Operating a Microcomputer," and "Computers: Today and Tomorrow." Primary through intermediate grades.

Computers, the Friendly Invasion. Film and guide. Walt Disney Educational Media, 1982. 20 minutes.

Designed to familiarize students with the vast array of computer applications, this film shows how computers work, the many tasks they perform, and the opportunities they offer in science and the arts. Grades 5 through 12.

Computers and the New World of Work. Filmstrip, cassette, and guide. Educational Design, 1983.

This filmstrip teaches skills and attitudes needed to work with computers, introduces the new computer-oriented world of work, and shows how to cope with the new technology. It tells how computers work, what they do, and what computer job opportunities are; it also explains what skills are needed to enter this new work force. Contents include "Working with Computers," "What Computers Do," "How Computers Work," and "Jobs and Computers."

Computers: Tools for People. Film and guide. Churchill Films, 1983. 24 minutes.

This provides an overview of the uses of computers and the ways people direct them, and it emphasizes the links between the power of computers and the creativity of humans. The film and guide briefly examine four types of applications programs—file searching, machine control, models, and creative tools—from an identifiable, humanistic perspective. Intermediate grades to adult.

Computers: What They're All About. Filmstrip, cassettes, and guides. January Productions, 1983.

The package teaches how computers work, with emphasis on microcomputers, and introduces programming and flow-charting. Contents include "The ABC's of the Computer," "Between You and the Computer," "What's on the Computer's Mind," "Getting in Step," and "Telling a Computer What to Do." Intermediate grades through junior high school.

. . . never in the life of a farmer, sailor, merchant, physician, or laboratory experimenter, does knowledge mean primarily a store of information aloof from doing.

—John Dewey

Discover Logo. Filmstrip, cassettes, guides, and work sheet masters. Educational Activities, 1983.

Two elementary-grade students instruct a group of adults in the fundamentals of Apple Logo, as art illustrations are mixed with shots of computer keyboards, monitor displays, and explanatory captions. Contents include "Communicating with the Turtle," "Teaching the Turtle to Remember," "Exploring with the Turtle," and "Creating with the Turtle." Grades 3 through 5.

Goodbye Gutenberg. WNET 13/BBC/Films Incorporated, 1981. 90 minutes.

This is a documentary on the communication and information revolution that has taken place in business and industry through the convergence of computers, word processing, and television technology. The film illustrates the changing technology in diverse fields such as newspaper publishing and reporting and the postal delivery service, notes the effects of federal regulations governing communications, and considers the issue of privacy.

Learning about Computers. VHS videotape and guide. National Geographic Society, 1984. 12 minutes.

Through the eyes of a boy using his family's home computer, this video introduces what computers do, how they work, their major parts and roles, what a chip is and does, how people are using computers now, and what future uses may be.

The following is a list of video programs broadcast during the school year on the Wisconsin Public Television Network and its affiliates.

The Computer Room. TV Ontario, Chapel Hill, NC, 1986. Ten 15-minute programs.

The Computer Room is a series of ten 15-minute programs designed to introduce middle-school students to a variety of computer studies topics. Each program is divided into four or five short segments. Many programs provide a software discussion, while others feature the brief Computer Room Scrap Book, giving vignettes from the history of computers. One short segment in each program is called Rimmer's Room, run by resident hacker Steve Rimmer, who shows students the "nuts and bolts" of computer hardware. Grades 4 through 7; science/computer studies.

Program 1. Modems; Telecommunicating by Computer; A Rock Radio Station

Program 2. Manufacturing a Modem; Using Computers to Design Products; Designing a Computer

Program 3. Upward Bound; Computer-Operated Museum Exhibits; How Tubes Run a UNIVAC; Building Computers

Program 4. Computerized Music; Computerized Cars; A Tour Inside a Computer

Program 5. Computerized Banking; Automatic Bar-Code Readers; Computerized Health Check-ups; Cable Television and Computers

Program 6. Voice-Operated Computers; Computers and Telephone Technology; Computerized Shopping

Program 7. Computers in the Family; Computers and Newspapers; Computers and Writing

Program 8. Computers and Movie Special Effects; Robotic Devices; Mainframe Computers; Designing/Building Cars with Computers

Program 9. Using Computers to Make Computers; Computerized Message Boards; Disk Drives; Controlling Building Climate with Computers

Program 10. Art and the Computer; Computerized Billboards; Computers in Space

Featherby's Fables. WVUT-TV, Vincennes, IN, 1983.

The overall objective of *Featherby's Fables* is to create an environment in the classroom in which the exploration of basic science concepts is exciting and attractive to both the primary-level student and educator. The programs are designed as a motivational tool which will stimulate student interest. They can provide a starting point from which the classroom teacher may employ established techniques to reinforce the material presented in the series. The specific programs described below could be particularly useful for computer education.

Program 5. *Computers—What They Can Do, What They Can't Do.* This teaches the following concepts: a computer can only do what it is programmed to do; computers can pass information to other computers; computers can't have opinions or emotions; and computers can do tasks quickly.

. . . a computer can only do what it is programmed to do . . . .

Program 11. *Special Purpose Computers.* This teaches the following concepts: a special purpose computer is one that does a special job; special purpose computers are in all kinds of things such as digital clocks, microwave ovens, cameras, and televisions; and special purpose computers are designed to do one job and to do it the same way each time.

Program 13. *Computers—What Are They?* This program teaches the following concepts: computers use a special code or language; programmers need to know the code to use in order to program computers; and a knowledge of computers will be more important as time goes on.

Arts Alive. Thirteen 15-minute programs. Agency for Instructional Television, Bloomington, IN, 1986.

Arts Alive is designed to help students better understand, appreciate, and respond to the arts. The series focuses on four art forms: visual arts, dance, music, and drama. Programs are a combination of dramatic and documentary formats. The dramatic segments show students in school settings, creating and responding to the arts. The documentary segments show professional adult artists performing and discussing their work. *Arts Alive* also encourages young people to become involved in the arts—to participate in creation and enjoy the benefits. The series was developed for use by both the non-arts teacher and the arts specialist. Series host is Lynn Swan, broadcaster for ABC Sports, former wide receiver for the Pittsburgh Steelers, and a dedicated supporter of and participant in the arts. The specific program described below could be particularly useful for computer education. Grades 6 through 9.

Program 12. *Arts and Technology*. This lesson shows that artists may use electronic technology to create in the arts. Acquisition of the necessary skills and knowledge is important to artists who choose to create with these new tools. Throughout history, there are examples of the arts being affected by artists using new tools: the visual arts were affected by the invention of stable oil pigments; dance changed with the invention of hard-toed ballet shoes; theatre was changed by the advent of electric lighting; and music changed with the development of the modern piano. Electronic technology is having a similar effect on all artistic media. When artists use a type of electronic technology as an artistic tool, the nature of the creative act is changed. For example, when a composer uses a synthesizer, much of the creativity involved occurs when the computer is programmed. Key terms in the lesson are *electronic technology, computer graphics (arts), graphics tablet (pad), computer program, laser, laser photography, synthesizer, electronic music, laser light show*, and *space theatre*.

When artists use a type of electronic technology as an artistic tool, the nature of the creative act is changed.

Spaces. Six 30-minute programs. The Greater Washington Educational Television Association, Washington, DC, 1986.

Astronaut, psychophysiologist, entomologist, solar energy physicist, statistician—*Spaces* encourages young people to dream about their futures and then challenges them to make their dreams come true. Programs introduce students to people and careers in science and technology and serve as tools with which to encourage students, particularly minorities, to pursue careers in these areas. Successful Asian, Black, Hispanic,

and Native American scientists, technicians, and students are featured. Five segments make up each magazine-format program. "Adult Profiles" shows successful minority scientists in their work, home, and community environments. "Student Profiles" introduces minority teenagers involved in science-related projects. "Connections" demonstrates how science is related to everyday activities. "Name droppers" presents historical contributions of minority scientists. "Mindblowers" uses animated science facts to excite the imagination. The two specific programs described below could be particularly useful for computer education. Grades 5 through 8.

Program 3. *Computers.* Featured in the computer show are Lee Ray and Nancy Wallace, who are each investigating techniques for utilizing computers in different ways—one in music and the other in industrial engineering. The versatility of the computer seems to be limited only by the programmer's imagination and skills and the availability of the most appropriate computer for the specific job.

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Program 6. *Communications.* This show presents an opportunity to meet two professionals whose careers in communications may provide insight into the often-overlooked distinction between natural and applied science. The featured physicist, Dr. George Campbell, conducts research experiments to help him create theoretical models. The models will lead to the development of satellites that can operate at maximum capacity, even under adverse conditions. Raquel White, an engineer, uses her technological expertise to create new products in electronic communications for Lourdes Industries. She applies the information and theories developed by research scientists in ways that enable society to make practical use of them.

Keys to the Office. Eight programs. TV Ontario, Chapel Hill, NC, 1986.

Keys to the Office was created to assist intermediate and senior students in making the transition from the classroom to the business world. Each of the eight 15-minute programs demonstrates basic skills, concepts, and attitudes essential for success in business. Program 4 may be particularly useful for computer education.

Program 4. *Information Please.* Any information worth keeping must be easy to locate. More than one million new pieces of information are created daily in Canada alone and storage and management of this vast accumulation is costly. The program examines a variety of storage and retrieval methods and the media used in office environments. Key topics include creating a database, information life cycle, storage media and retrieval systems, and information management.

Any information worth keeping must be easy to locate.

Computer Science

Advanced Placement Course Description: Computer Science. New York: College Entrance Examination Board, 1986.

Teachers Guide to Advanced Placement Courses in Computer Science. New York: College Entrance Examination Board, 1983.

Keyboarding

Ball, Stanley. *Valuable Alternatives to Keyboarding in Grades K-3.* Sept. 1985. ERIC ED 264 957.

This paper was presented at the Fall Conference on Perspectives on the Young Child and the Computer (Austin, TX, Sept. 1985).

According to Ball, computer use in early childhood is likely to continue to increase. However, there is reason for concern about how computers will be placed into classrooms, what activities will be chosen for children, what interactions will take place, and whether those planning these interactions will consider appropriate readiness and development levels. Computers should be used to promote cognitive development of young people in the classroom. Such use should (1) take advantage of the powerful interactive nature of the computer, (2) consider the readiness of the child, and (3) not require sophisticated keyboarding skills. Research and reviews of software suggest that software satisfying these criteria is available. Included in this document is a list of 20 software packages reviewers see as promoting thought processes in kindergarten children and primary school students.

Computers should be used to promote cognitive development of young people in the classroom.

Connecticut State Department of Education. *Microcomputer Keyboarding Curriculum for Middle and Junior High School Students: Final Report.* Hartford, CT: Department of Education, Bureau of Vocational Program Planning and Development, 1986. ERIC ED 251 649.

This project report describes the development of a seventh-grade curriculum to promote microcomputer keyboarding skills, such as learning correct alphanumeric reaches, developing proficiency in making appropriate reaches, using correct fingering without looking at the keyboard, and attaining a degree of speed and accuracy. Although the curriculum was piloted with approximately 200 seventh-grade students, it was designed for use in grades 6, 7, or 8. A curriculum guide for microcomputer key-

boarding and an instrument to evaluate the curriculum were developed. Midway through the pilot, the curriculum was evaluated and upgraded based on a semester's experience.

Pre- and post-test scores indicated that all students, including those in special education, improved their keyboarding speed and accuracy. The keyboarding curriculum is appended to the report. It details the philosophy, objectives, and design of the course. Procedures are outlined, and student progress with the software is described. Both the advantages and disadvantages of microcomputer keyboarding are also discussed. Other sections offer suggestions for computer usage when not committed to keyboarding, conclusions, recommendations, lesson plans for an eight-week course, and pilot test results. A second appendix provides measuring instruments.

Cowles, Milly, et al. *An Analysis of Young Children Learning Keyboarding Skills*. Birmingham, AL: University of Alabama, 1983. ERIC ED 238 542.

The primary purpose of this study was to demonstrate whether children ages 5 through 8 could learn keyboarding skills. A secondary purpose was to examine the relationship between typing skill development and motor proficiency. A sample of 24 children was randomly selected from a group attending a summer school enrichment program. The Bruininks-Oseretsky Test of Motor Proficiency was used to measure children's gross and fine motor skills. After arm and leg preference for each child had been determined, gross motor, fine motor, and gross and fine motor skills subtests were administered. Subjects used IBM Selectric typewriters and a modified "Touch to Type Typing Program."

A teacher directed all instruction in 30-minute sessions for 19 days. At least one child development specialist observed each lesson to measure time-on-task behaviors and to search for obvious signs of frustration, enjoyment, and perseverance. Results indicated that young children can learn to type correctly and can do so without frustration. Seven- and 8-year-olds experienced success with words and sentences and stayed with the task; 5- and 6-year-olds progressed to words only. Observations suggested that being able to read was an important antecedent skill. Additional results showed that gross and fine motor proficiency were highly related to the success of the older children.

Results indicated that young children can learn to type correctly and can do so without frustration.

Erthal, Margaret J. "The Status of Keyboarding." *Journal of Business Education* 60.5 (Feb. 1985), pp. 192-93.

This article describes results of a questionnaire concerning such questions as, where is the first keyboarding/typing class taught, what is the length of this class, what equipment is utilized, and what are students in kindergarten through eighth grade doing with microcomputers. The author then makes suggestions for improving the curriculum for keyboarding in elementary grades.

Hall, Carol S. *Keyboarding in a Self-Contained Fourth-Fifth Grade Classroom*. July 1985. ERIC ED 269 130.

This paper was presented at the North Carolina Educational Microcomputer Conference (Greensboro, NC, October 1-2, 1985) and at the Computer Coordinator's FOCUS '85 Workshop (Raleigh, NC, October 29, 1985). It is part of a master's project for the University of North Carolina at Greensboro.

Keyboarding was taught to a group of 26 fourth- and fifth-grade students in a self-contained classroom by an elementary classroom teacher using an Apple IIe microcomputer and two software programs: *Gregg Personal Keyboarding* and *Typing Tutor II*. Intervention spanned 52 class days, including pre-, mid-, and post-test days, with each student having approximately 10 minutes of computer time per day. Total time of computer use was approximately 520 minutes per child. The instructional goal of the intervention required that students reach a speed of 20 gross words per minute (gwpm) with three or fewer errors per minute. Students achieved a mean speed of 19.73 gwpm, with an error rate of 5.96 on the 46-word timed writing instrument. Keyboarding scores were examined for differences associated with grade level, sex, reading ability, student access to typewriter or computer at home, and ability to play the piano.

Jackson, Truman H., and Diane Berg. "Elementary Keyboarding—Is It Important?" *Computing Teacher* 13.6 (March 1986), pp. 8, 10-11.

This article presents guidelines for keyboarding instruction in elementary schools. Topics addressed include whether keyboarding should be taught, where keyboarding fits within the curriculum, instruction time, instructional materials, equipment, furniture, teacher qualifications, teaching methods, student performance evaluation, and grading. Software packages for teaching keyboarding skills are listed.

Kisner, Evelyn. "Keyboarding—A Must in Tomorrow's World." *Computing Teacher* 11.6 (Feb. 1984), pp. 21-22.

Kisner describes keyboarding—entering information on electronic equipment through use of a typewriter-like keyboard—and briefly discusses when it should be taught, who should teach it, and what level of keyboarding efficiency is needed.

Sormunen, Carolee. "A Comparison on Two Methods for Teaching Keyboarding on the Microcomputer to Elementary Grade Students." *Delta Pi Epsilon Journal* 28.2 (Spring 1986), pp. 67-77.

This study compared two software programs for teaching keyboarding to students in grades 4, 5, and 6 and compared speed achievement when students were grouped by sex. One program was an educational game. The other used traditional psychological motor skill development theory as applied to typewriting instruction. Results are reported and discussed.

Sormunen, Carolee. "Inservice Workshops: One Answer to the Issue of Elementary School Keyboarding." *Journal of Business Education* 60.1 (Oct. 1984), pp. 14-17.

Sormunen considers the change in attitude about teaching keyboarding in the elementary school and outlines objectives for an inservice workshop to train elementary school teachers to teach keyboarding for computer literacy.

Warwood, Byrdeen, et al. *A Research Study to Determine the Effects of Early Keyboard Use Upon Student Development in Occupational Keyboarding: Final Report of Research*. Bozeman, MT: Montana State University, Sept. 1985. ERIC ED 265 367.

Before students can use microcomputers effectively, they need keyboarding skills. A project was conducted in Montana to teach keyboarding to fourth-grade children using computer-assisted instruction. Two fourth-grade classes at Hawthorne Elementary School, Bozeman, Montana, participated in an eight-week, 32-session elementary keyboarding pilot program. They were instructed with "Microtype, the Wonderful World of Paws," suitable for grades 3 through 6, which was selected following a literature search. The students took a pretest and then completed the eight-week course.

During the classes, it was found that more than one class period had to be spent on a lesson, especially in the beginning. Children also progressed more rapidly when the keyboards of the Apple microcomputers they were using were covered with paper. Significant progress was reported after the eight-week session, and a post-test showed that all children had made measurable gains in keyboarding skills. However, another post-test administered six weeks after the keyboarding class had finished showed that most of the gains were not maintained. The study concluded that it is feasible to teach keyboarding skills to elementary students and they can learn well, but that they need continuous practice to maintain the newly learned skills.

Wetzel, Keith. "Keyboarding Skills: Elementary, My Dear Teacher." *Computing Teacher* 12.9 (June 1985), pp. 15-19.

Wetzel discusses the need for development of keyboarding skills at the elementary school level; issues to be addressed when developing keyboarding curriculums—criteria for competence, how much is necessary, time needed, and who should teach and how; and program considerations—hardware, curriculum, principles of instruction, instructional periods, classroom or computer lab organization, and evaluation.

Computer Equity

"Computer Equity." *Computing Teacher* 11.8 (April 1984).

The 21 articles in this issue cover a wide range of topics, including analysis of inequities in computer learning opportunities by a computer equity researcher, examples of model school programs, a "how to" guide for identifying bias-free software, and a discussion of a study of solutions for addressing computer bias in schools.

Denbo, Sheryl, ed. *The Computer Explosion: Implications for Educational Equity*. Washington, DC: Mid-Atlantic Centers for Race and Sex Equity, The American University, 1983.

This book offers a collection of articles from several magazines reviewing the issues of race and sex equity in computer education. It includes an overview of computer equity issues; a discussion of instructional uses of computers; articles about evaluation software, including evaluation from an equity perspective; and a statistical overview of "computer workers."

Desegregation Assistance Center, Center for Sex Equity in Schools, School of Education, University of Michigan, Ann Arbor, MI.

The Desegregation Assistance Center serving the Great Lakes states (Region V) provides training and technical assistance to school personnel in race, sex, and national origin nondiscrimination. The center's services are free to any school district that requests them.

"EQUALS in Computer Technology," Lawrence Hall of Science, University of California, Berkely, CA 94720.

EQUALS in Computer Technology is an inservice program developed by the award-winning staff of the EQUALS project. EQUALS began by developing workshops for teachers and students to increase the enrollments of girls in high school math and science courses. It provides teachers with classroom strategies and materials to encourage participation in computer courses as well as to help develop thinking skills necessary to technical work. The program also includes information and experiences that enable students to master computers.

Schubert, Jane G., et al. *IDEAS for Equitable Computer Learning*. Palo Alto, CA: American Institute for Research, 1984. ERIC ED 272 138.

IDEAS for Equitable Computer Learning describes practical strategies that address 12 barriers to equitable learning. These strategies are based on actual experiences of students in grades 1 through 9, as assessed by the American Institute for Research staff. Teachers of computer programs helped design both the content and format of the booklet. *IDEAS*

was produced with a grant from the Women's Educational Equity Act Program.

McWilliams, Peter A. *Personal Computers and the Disabled*. New York: Doubleday, 1984.

McWilliams is the author of three best-selling books on computers. In this book, he catalogs adaptive devices for disabled computer users as well as organizations, government agencies, colleges with larger disabled student populations, computer societies that focus on the disabled community, newsletters, data banks, magazines, library services, and state agencies and counsels. The section on media lists major newspapers by region along with the names of editors who cover science, medicine, and computers.

National Center for Computer Equity, Project on Equal Education Rights, NOW Legal Defense and Education Fund. 1413 K Street, Northwest, 9th Floor, Washington, DC 20005; (202) 332-7337.

The National Center for Computer Equity functions both as a national clearinghouse and forum for the exchange of ideas and programs on equity in computer education. Its purpose is to link together educators, parents, policy makers, business leaders, and researchers to define and resolve problems of discrimination and exclusion affecting girls of all ethnic and racial groups, including disabled girls, in computer equity reports on a broad range of computer equity issues. The center provides a computer equity action kit for use in local school districts and communities. In addition, the center is now actively soliciting information on school and community programs that are successfully providing bias-free computer-based education.

The National Center for Computer Equity functions both as a national clearinghouse and forum for the exchange of ideas and programs on equity in computer education.

Wallace, Joy, and Raymond M. Rose. "A Hard Look at Software: What to Examine and Evaluate (With an Evaluation Form)." *Educational Technology* 24.10 (Oct. 1984).

This article offers practical advice for reviewing software from an equity perspective.

Wisconsin Department of Public Instruction, Bureau for Equal Educational Opportunity, Sex Equity Program, P.O. Box 7841, Madison, WI 53707; (608) 267-9157.

This state education agency program is provided with federal Civil Rights Act Title IV funds to assist in implementing civil rights laws and provide technical assistance in all areas of educational equity.

Appendix A

Summary of Equity Issues

Issues related to computer equity for students who are disadvantaged, female, or members of racial and/or ethnic minority groups fall into three areas: (1) access to computer literacy and computer-assisted learning, (2) tracking through differential uses of computer technology, and (3) exposure to bias and stereotyping in educational software. Key questions for each of these three areas follow.

Access to Computer Literacy and Computer-Assisted Learning

- Do school districts with lower tax revenues have fewer computers than do districts with higher tax bases?
- Are the schools with the fewest computers situated in neighborhoods where inhabitants have low socioeconomic status and parents are less likely to have personal computers in their homes?
- Within an individual school district, are there fewer computers in schools with less influential and/or less affluent parent groups?
- How are the students selected for computer time? Are the computers considered more appropriate for certain groups of students on the basis of their academic achievement, sex, race/ethnic group, learning disability, or socioeconomic level?
- Is the math anxiety sometimes experienced by females transformed into machine anxiety that limits female students' access to computer technology?
- What role do teacher and student expectations and stereotyping play in the selection of students for computer time?
- Is there differential access to staff development activities, so that teachers of certain groups—minorities, the handicapped, lower-achieving students—are less likely to have access to computer literacy and computer-assisted learning?

Tracking through Differential Instructional Uses of the Computer

- Are higher-achieving students using the computers for simulations and development of higher-order skills, while special education students and lower achievers are restricted to drill and practice activities?
- Are male students given opportunities to explore higher-order skills and simulations, while female students' opportunities focus primarily on word processing and record keeping?
- Is time on the computer seen as a reward for certain groups of students and as a punishment for others?
- Does available educational software emphasize one learning style that has a negative impact on certain groups of students because of their race, ethnic group, sex, or cultural background?

Exposure to Bias, Stereotyping, and Negative Values Inherent in the Educational Software

- Does available educational software use language that reflects bias on the basis of race, sex, ethnic group, or disability?
- Does available educational software—text or graphics—reflect stereotyping on the basis of race, ethnic group, sex, or disability?
- Does available educational software present the contributions of racial and ethnic groups and females and males in unrealistic and/or historically inaccurate ways?
- Are females and minorities excluded or underrepresented in either the text or graphics of available educational software?
- Does available educational software depict violence or use extreme forms of competition either in instruction or to reward successful completion of an instructional task?

Appendix B

Keyboarding

Who Should Teach Keyboarding

The ideal elementary keyboarding instructor is a business education teacher certified at the elementary level or a cooperative team made up of secondary business education and elementary teachers. When the cooperative approach is used, business teachers should get inservice training on elementary-aged children's developmental stages and learning principles, and elementary teachers should be inserviced on keyboarding and methods of teaching keyboarding. A number of individuals might be keyboarding instructors.

- A secondary business education teacher
- An elementary school teacher
- A computer coordinator
- A traveling districtwide teacher for elementary schools
- A team of elementary school teachers with a coordinator, possibly a secondary business education teacher

It is important that a keyboarding teacher have adequate keyboarding skills in order to provide the proper foundation for students.

What Is the Teacher's Role in Keyboarding?

Whether keyboarding is taught "live" with a teacher directing the activities or in the tutorial mode with computer diskettes delivering the instruction, the role of the teacher is central.

When keyboarding is taught by a teacher/textbook strategy, the teacher must insure that the following take place.

- Modeling. Each aspect of a technique to be learned is demonstrated frequently.
- Reinforcement. The teacher provides feedback regarding results of practice—confirmation or correction of keyboarding techniques as determined by observing students at work.
- Individualized goal setting. The teacher helps each student set new goal(s) on the basis of her/his own most recent performance, whether the goal(s) be related to technique, speed, or accuracy improvement.
- Pacing. The teacher leads students to progressively higher levels of keystroking by continually setting a pace just beyond their current keystroking speeds—by dictating practice copy at a predetermined speed, typing with the students at a preselected speed, or using specially counted copy and a stopwatch and calling completion guides each 15 or 20 seconds to help students maintain a preselected rate per minute.
- Differentiated practice. After the new-key learning, the instructor assures that what and how various students practice is geared to their individual needs.
- Evaluation. The instructor assesses how nearly each learner is approaching preset goals. Techniques can be evaluated only by observation: speed by timed writing and accuracy by checking the papers students produce. Such evaluation should be formative, used only to provide suggestions for better practice methods that will lead to improved performance.

When a well-designed diskette program delivers the keyboarding instruction, most of the foregoing conditions are implemented. Computers do have their limitations, however. They cannot observe students at work and make appropriate suggestions for improved keyboarding behavior. Computers cannot deal with learning problems that derive from students' emotions and attitudes. A knowledgeable, well-trained teacher must supply these missing links in the computer-as-tutor mode.

How Should Keyboarding Be Taught?

As in any class, students in keyboarding courses will have markedly different capabilities, learning styles, and so on. In determining instructional materials and methods to be used, then, teachers must acknowledge and respect individual differences. Any activity that keeps a group of students together and moving at the same pace should be used for minimal amounts of time only, so that faster students are not inhibited by slower students, and slower students are not frustrated by faster students.

It is important, particularly among elementary students, to use a variety of approaches to teach keyboarding. For instruction in specific skills, a large-group approach might be best. An individualized approach might be better for ongoing drills, practice, and application.

How Long Should Keyboarding Be Taught?

Research on this subject suggests no magic time allotment. However, several typing studies may serve as examples of the time frame needed. McClurg (1984) found two studies which reported the typing speed of intermediate students. Fifth and sixth graders typed an average of 40 words per minute after one year of instruction for one hour per day (Ray, 1977). Fifth graders typed an average of 22 gross words per minute after nine weeks of instruction at 45 minutes per day (Kercher, 1984).

In 1984, Lewie Hendersen-Lancett reported on the time required for teaching elementary-aged students keyboarding and word processing skills. "Children have shown they can learn both touch-typing and word processing in as little as eight hours! This enables them to create stories on the computer at speeds of 15 words per minute. This is quite adequate."

Such reports strengthen the case for the effectiveness of a minimal but definite time allotment for keyboarding instruction. Most students in grades 3 through 5 will average ten gross words per minute after receiving instruction and practice on a microcomputer typing tutorial for 35 minutes per day for four weeks. If this schedule is extended to nine weeks, the average student will type 15 to 20 gross words per minute.

How Should Hardware Be Deployed?

There are two major ways in which computers can be organized to teach keyboarding—in labs, where all students are learning at the same time; or in a classroom, where one or two computers are in use while other learning activities are being taught.

The lab arrangement has several advantages.

- Students at the computer do not miss group instruction or disturb the class when they take turns.
- All students get a turn at the computer.

- A lab makes the most efficient use of computer time (Becker, 1984).
- Practice comes immediately after instruction.

The classroom arrangement has different advantages.

- Students do not need to leave the classroom to practice.
- The classroom teacher monitors student activities.
- One or two computers in a class can serve all students.
- Nothing in the curriculum has to be supplanted.

In both arrangements, practice can be accomplished with a combination of tutorials and games.

Hardware Evaluation Work Sheet

On the tally sheet below, assign an *importance* factor of 1 to 3 for each category, depending on how important you think each category is to your decision. The factor should be developed by your district committee and should be consistent as you rate various machines. 1 = Not important; 2 = Important; 3 = Very important.

As you compare machines, give each one a *rating* of 1 to 3 in each category (1 = Poor; 2 = Average; 3 = Good). For example, if dealer service is not available, give it a 1 under the "Service" category; if it is good, give it a 3. If the machine is easily moved and compact, the "Flexibility" category may get a 2 or 3. If no software is available, that category may be given a 1.

When all the categories have been rated, multiply them by the importance factor you originally assigned. The end results are then added together. The highest total will indicate the microcomputer best suited for your uses. Be as sincere as possible to get an unbiased evaluation.

Sample

Brand: Brand X			
Category	**Importance Factor (1 to 3)**	**Rating (1 to 3)**	**Total**
Cost	*3*	*2*	*6*
Service	*2*	*1*	*2*
User training	*1*	*3*	*3*

Brand:			
Category	**Importance Factor (1 to 3)**	**Rating (1 to 3)**	**Total**
Cost			
Service			
User training			
System expansion			
Flexibility			
Software			
Memory			
Keyboard			
Display			
Peripherals and options			
Sound, music, voice, graphics			

Total _____

Brand:			
Category	Importance Factor (1 to 3)	Rating (1 to 3)	Total
Cost			
Service			
User training			
System expansion			
Flexibility			
Software			
Memory			
Keyboard			
Display			
Peripherals and options			
Sound, music, voice, graphics			

Total _____

Brand:			
Category	Importance Factor (1 to 3)	Rating (1 to 3)	Total
Cost			
Service			
User training			
System expansion			
Flexibility			
Software			
Memory			
Keyboard			
Display			
Peripherals and options			
Sound, music, voice, graphics			

Total _____

Program Modification Work Sheets

Areas of Strength

Area/Department _____

Conclusion (Commendation)	Maintenance Strategies	Person(s) Responsible
		Facility Needs
		Resources (equipment, learning materials, and so on) Item Cost
		Completion Date
		Implementation Priority (circle one) Least Important 1 2 Most Important 3
		Comments

Areas of Improvement

Area/Department _____

Conclusion (Needs Improvement)	**Recommendations (Suggested Solutions)**	**Person(s) Responsible** **Facility Needs** **Resources (equipment, learning materials, and so on)** Item Cost **Completion Date** **Implementation Priority (circle one)** Least Important 1 2 Most Important 3 **Comments**

Program Improvement Plan

☐ Staff Development ☐ Computer Facilities ☐ Computer Hardware ☐ Computer Software
☐ Curricular Integration ☐ Computer Literacy ☐ Computer Science

Program Improvement Category (in descending rank order)	Person(s) Responsible	Facility Needs	Resources		Completion Date	Comments
			Item	Cost		

School District Standards that Affect Computers in Education

Wisconsin Statutes, 121.02
Administrative Rule PI 8

(k) Each school district board shall develop, adopt and implement a written school district curriculum plan which includes the following:

a. A kindergarten through grade 12 sequential curriculum plan in each of the following subject areas: reading, language arts, mathematics, social studies, science, health, computer literacy, environmental education, physical education, art and music.

The school district curriculum plan shall provide that:

a. Computer literacy objectives and activities shall be integrated into the kindergarten through grade 12 sequential curriculum plans.

Computer Literacy

The ability to use suitable computer programs in appropriate ways to assist in learning, handling information, and solving problems; and the ability to make informed judgments concerning social and ethical issues involving computers and information systems.

Computer-related objectives and activities should be integrated into the K-12 curriculum, particularly (but not limited to) mathematics, social studies, science, and language arts.

Curriculum Plan

Each sequential curriculum plan shall specify objectives, course sequence, course content, resources and an allocation of instructional time by week, semester and school term. The school district board shall establish in the school district curriculum plan the allocation of instructional time, by week, semester and school term, among all subject areas.

Evaluation

Each sequential curriculum plan shall include a program evaluation method which provides a systematic, continuous and objective process of determining whether pupils attain the specified objectives.

Components of the sequential curriculum plan shall be monitored continuously and the overall program evaluation methods shall be reviewed at least once every five years and revised as appropriate to ensure that pupils meet the curriculum objectives.